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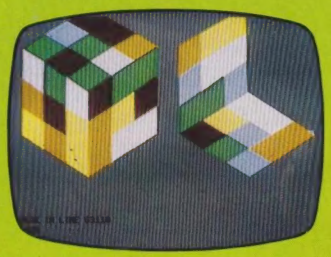

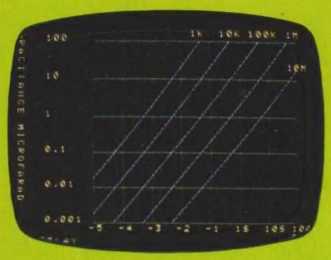

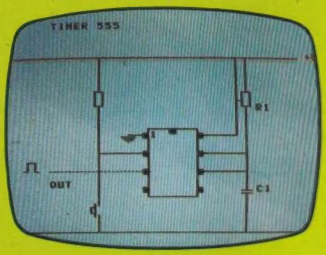

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

All material should be typed. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Charing Cross Road address.

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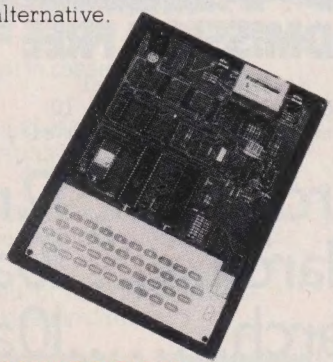

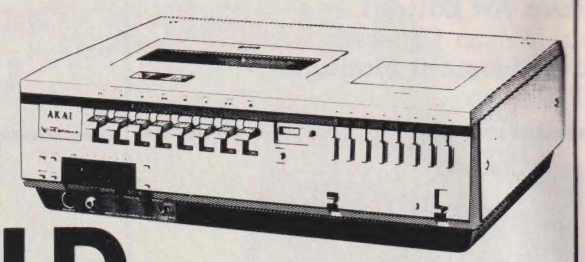

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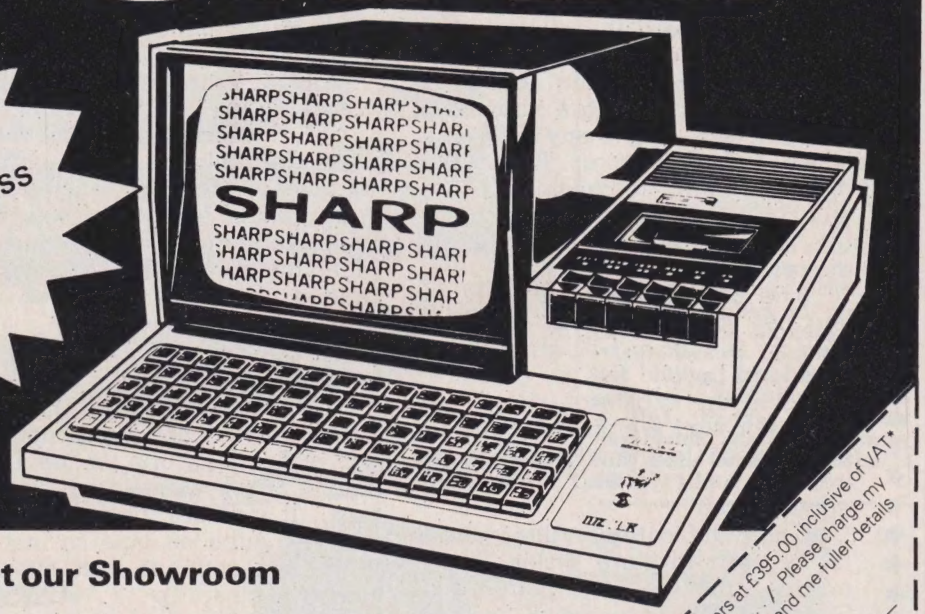

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STATESIDE

One of the most exciting developments to hit the personal computing industry over here has to be the introduction of the new IBM personal computer. Utilising the Intel 8088 16-bit CPU, the IBM may be considered in a class of its own having allowed for support and expansion of up to 256K of main memory.

The Hard Bit!

The computer comes as a basic four-piece ensemble, having separate keyboard mainframe, VDU and printer components. A cassette interface is provided with capacity to add two 5¼" disc drives of 160K capacity each.

The keyboard is excellent, being physically strong and adjustable for two different typing angles. It has 83 keys including a numerical keypad and has many versatile features including a 'Typamatic' facility allowing automatic repeat of any key being held down and audible 'click' heard as each key is depressed.

The unit utilises 40K of ROM and has sockets for 64K of RAM. Memory in 32K or 64K groups may be added beyond 64K by cards inserted in the expansion slots. Five expansion slots are provided and all connections to the unit are made from the rear, yielding a very neat appearance.

The ROM is used in three ways. 2K is used to store system diagnostics, the Basic Input/Output System (BIOS) occupies 6K and the remaining 32K is occupied by probably the most complete version of BASIC to reside in a personal computer — a cassette version written by Microsoft. When the discs are booted, two extensions become available adding graphics, file capabilities and music.

The VDU, with upper and lower case (true descenders), has the capability to display foreign language characters, blinking display, inverse video and underlining. The display device itself does not support graphics; a colour graphics card must be installed in one of the slots. The adaptor comes with 16K of memory used for graphics storage, freeing program memory. Two text modes are available, presented in 25 lines of either 40 or 80 columns. Low resolution mode can utilise text size blocks to display in eight background and sixteen foreground colours. Medium resolution display makes available 200 vertical and 320 horizontal dots using only four colours; high resolution mode uses 200 vertical and 640 horizontal dots although this is presented in monochrome.

The DOS used by IBM is essentially equivalent to CP/M. Disc formatting is very fast, as is disc copying and comparing — well under a minute in all cases. Operation is clear and trouble free.

The IBM system documentation is merely excellent, the manuals being colour-coded, easy to read and understand.

Industry reaction has been interesting, to say the least. The primary criticism has been one of price. Certainly the IBM machine is not cheap. However, if the consumer wants to spend some time comparing system prices and the capability of the system to be expanded, the IBM compares very well indeed.

Nibbles

Computerware of Encinitas has recently announced a computer version of Rubik's Cube for the Tandy (Radio Shack as it is called over here). It includes the capability to save the cube on tape so that the player can continue later after the headache clears up.....Computer-Mat of Arizona has announced a game for the PET called Astroidz based on the famous and challenging arcade game.....Personal Software has announced VisiFile, an addition to the VisiCalc series, designed to handle report printing, search and sort records and print mailing labels.....Software Resources Inc of Cambridge, MA, has introduced a VisiCalc program that combines graphics and analysis in order to generate graphics displays, compute statistical functions, print graphs and tables, plot trend lines as well as edit and update both its own and other VisiCalc files.

Bud Izen
Davis, California

COMPUTER CONFUSION

Readers may be confused by the two quite separate London Computer Fairs taking place this April. Two? I hear you chorus. Yes, but don't worry, there's only one original, co-sponsored by Educational Computing and another very well-respected Computing magazine (we don't like to boast...well, not too openly anyway). The Association of London Computer Clubs have organised their third London Computer Fair for April 15-17 at the Polytechnic of North London. The organisers are planning to expand the exhibition floor space by 50% allowing 48 stands; provision having been made for over 10,000 visitors. There will also be a three day residential 'Computers in Education' conference associated with the Fair. So remember, accept no substitutes, make a date in your diary to visit the original London Computer Fair. For more detailed enthusiasm, contact Robin Bradbeer, at the Polytechnic of North London, Department of Electronics and Communications Engineering, Holloway Road, London N7 8DB or telephone him on 01-607 2789.

VIDEO EXTRA

To enhance the video display of any TRS-80 Model 1 is the AV-1 board, newly available from RHA (Minisystems) Ltd. The AV-1 offers the addition of Scripsit compatible lower case, giving a total of 96 ASCII characters; all of which can be displayed in positive (white or black) or inverted (black on white) video. The 64 graphics characters are retained to a total of 256 different characters and the whole screen, including borders, may be inverted under separate control. The AV-1 board, priced at £23 + VAT, is totally compatible with exisiting software. For further details contact RHA (Minisystems) Ltd at 83, Gidley Way, Horspath, Oxford OX9 1TQ or telephone them on 08677-3625.

BBC MICRO SUPPORT

The BBC's Microcomputer and Computer Literacy Programs are to be supported by Catron Micro Centre whose branches in Sheffield and Derby will be acting as Referral Centres. Ian Dunkley, Datron's Managing Director and Chairman of the Computer Retailers Association, while an outspoken critic of the commercial aspects of the machine, he is eager to provide local support for their wide base of educational users. Ian Dunkley can be reached at the Datron Micro Centre, 2, Abbeydale Road, Sheffield S7 1FD or by telephone on 0742-585490.

CONSUMER NEWS

◀STORED OF THE RINGS

Two new cassette data storage devices are available from Ikon Computer Products. First up is the Hobbit, a fast mini-cassette data storage system capable of creating up to 69 files on both sides of the tape with over 51K per side. The firmware provides delete, list, load, dump, rename and other instructions and is completely compatible with their other new product, the FV1. The FV1 is a cassette-based data storage system easily connected to any computer via an RS232 serial link and boasts a storage capacity of 101K per cassette – a total of 104 files. There is full internal buffering and data may be transmitted in blocks of between 1 and 99 bytes, with a comprehensive error checking of commands. The prices of the Hobbit and the FV1 are £99 + VAT and £235 + VAT respectively. Further information is available from Ikon Computer Products, Kiln Lake, Laugharne, Carmarthen, Dyfed.

IS VIC THERE?▶

Arfon have introduced a new expansion board which will upgrade the VIC 20 into a seven cartridge, fully integrated system. Firmly secured to the aluminium base of the VIC 20, there is also space at the rear of the expansion board to allow a modulator to be sited. Memory cartridges are available immediately with a choice of 3K at £26, 8K at £39 and 16K at £65. Arfon are also providing a full range of upmarket software cartridges and functional cartridges, ie RS232, user port, expansion speech, music, disc controller, etc. A more powerful supply has been developed to power the VIC and its expansion and this is priced at £100, the expansion board is available at £85 + VAT. Further enquiries should be directed to Arfon Microelectronics Ltd, Cibyn Industrial Estate, Caernarfon, Gwynedd, Wales LL55 2BD or by telephone on 0286-5005.

TWO FOR OHIO

Two new products have been introduced to compliment the range of Ohio Scientific computers and the UK101. A 680 expansion board offers the following facilities: Centronics compatible output port; IEEE compatible I/O port; space for up to 8K of EPROM; and 2K of battery-backed non-volatile RAM. Complete with all cables and conections, the board is priced at £165 + VAT. A 2K firmware package in EPROM, Starlink, has been designed to give communications handling facilities to OSI and UK101 users. The software supports 'indirect-file'-type operations enabling data to be manipulated either as programs or as text and easily converted between formats; thus word processing techniques may be applied to program development. Supplied with comprehensive documentation and fitting instructions, the package is available for £19.50 + VAT. Further information from Mutek, The Studio, Quarry Hill, Box, Corsham, Wiltshire SN14 9HT.

VIDEO PROGRAM

John Wiley & Sons have introduced a video package 'Programming In Pascal' as a series of sixteen half hour video programmes taking the uninitiated programmer through conceptual explanations, various examples and practical exercises. The series is produced by Sheffield University and features Lawrence Atkinson, known to many of you as the author of the best selling text on Pascal Programming. The price of the package is £1250 + VAT, with special discounts offered to UK Educational Institutions, and sample tapes can be obtained for £25.00. While we're here, if any of you couldn't afford the cloth edition of the excellent 'Writing Interactive Compilers and Interpreters' by PJ Brown, good news, it's now been published in paperback ISBN 0471 100722, price £5.95. Further details can be obtained from John Wiley & Sons Ltd, Baffins Lane, Chichester, Sussex PO19 1UD or 'phone them on 0243-784531.

A BIT OF STICK?▶

How would you like to create multi-colour graphics, sketches, technical drawings, electronic circuit diagrams, typography, as well as a host of visual effects? Using a new hardware/software package called the BIT STIK system, this is now possible for only £185 + VAT. Initially the BIT STIK system is available for use with any 48K Apple system with DOS and colour/black & white monitor. However, interface modules and modified software will shortly be available for other machines. The designers are also currently working on a number of allied product developments which will utilise some of the unique features of the BIT STIK, including software for a dynamic 3D transform package. Further information can be obtained from ROBOCOM Ltd, CIL Trading Estate, Fonthill Road, London N4 or by 'phoning 01-836 1072.

MICROGEN ZX81
QUALITY PRODUCTS

JOYSTICKS FOR THE ZX81
AS SEEN AT THE ZX MICROFAIR

Micro Gen proudly announce the most exciting development ever for the ZX81. This add on effectively turns your ZX81 into a true programmable games machine. Benefits are a responsive interface between the ZX81 and the user play space invaders, breakout etc like you have never played before!

Free yourself of that dead unresponsive keyboard and even if you have bought an add on keyboard our joystick package will enable you to play games with far more enjoyment and efficiency.

The controller board connects between the ram pack and the ZX81. (It does not affect the normal operation of the machine and no special skill is required to make this connection.) This board has the facility to accept one or two joysticks. Games using two joysticks so by allowing two players to play against one another will be announced in the near future.

It is our intention to market a wide range of cassettes similar to that of the popular cartridge games machines on the market but at an extremely competitive price. Detailed instructions will be supplied to enable our customers to use the joysticks in their own programmes you will require one joystick and a controller board for the games presently available. If you write a programme which is exceptional please submit it to us and we will consider marketing it on a royalty base.

Prices are Controller board £19.80 inc VAT, Joystick £9.60 inc VAT. Please add 0.80p p+p

Games available for the joysticks ZX Space Invaders + ZX Maze £6.95, ZX Breakout £4.50. Please add 40p p+p (Dealer enquiries welcomed)

Other games available (not using joysticks).

ZX81 CHESS

LOOK AT THESE FEATURES

- ★ Graphic display of positions on chess board
- ★ Displays seperate record of your move and the computers
- ★ Written in superfast machine code
- ★ Plays all legal moves including castling and enpassant but if an illegal move is entered will answer illegal move
- ★ Six levels of play
- ★ Random weighting computer doesn't always play the same move in an identical situation.
- ★ Board can be set up to any configuration and you can even after or exchange sides in midgame.
- ★ Amazing power in 10K of memory

PLUS CHESS CLOCK!

- ★ Records and display time taken per player
- ★ Resetable function
- ★ Single key entry

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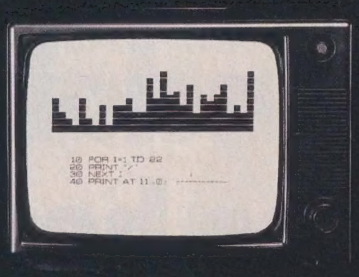
sinclair ZX81 PERSONAL COMPUTER



Sinclair ZX81 Personal Comp

the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

uter-

Available now- the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

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	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

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*Please charge to my Access/Barclaycard/Trustcard account no.

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How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING	CHR$	●	●		●	●		●
FUNCTIONS	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm 10^{\pm 38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC	A-Z			●			●	
VARIABLES	AA-ZØ				●	●		●
	An-Zn, n=any alphanumeric string	●	●					
STRING	A$ & B$						●	
VARIABLES	A$ to Z$	●	●	●				
	An$ to Zn$ n=any alphanumeric character				●	●		●
NUMERIC	SINGLE DIMENSIONAL		●	●			●	
ARRAYS	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL	USR (CALL, LINK)	●	●	●	●	●		●
FEATURES	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

Sinclair software on cassette.

The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

The ultimate course in ZX81 BASIC programming.

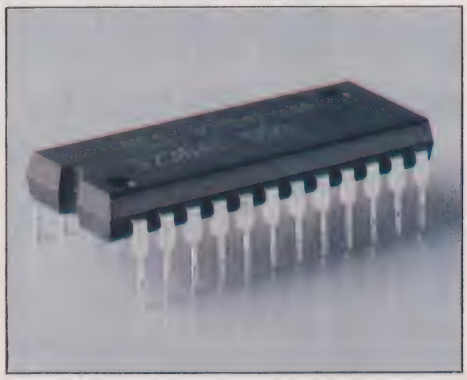
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

sinclair
ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

WHENEVER YOU HEAR
THE WORDS

Marksman & Apple

YOU PROBABLY THINK OF
WILLIAM TELL . . .

. . . BUT FROM TODAY
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MERCURY

When you connect up to six Apple II micros together sharing up to 80mb of Marksman Fixed Disk you have a system which works at the speed of Quicksilver. You are not buying a networking system but are buying Mainframe capability at a price you can afford. Mercury is an operating system for the Apple II which can be used either on a single Apple II with floppy drives or on one or more Apple II's with from 5mb to 80mb of fixed disk. The fixed disk is backed up by a Data streamer device which dumps 20mb in 4 minutes on a ¼" tape cartridge device.

WHAT IS SO UNIQUE ABOUT MERCURY?

Simple, it changes your micro computer into a mainframe computer by providing file access methods which before now were only to be found on processors up to fifty times the price. Mercury gives you full DIRECT and INDEX SEQUENTIAL ACCESS METHODS of file handling, which gives your Apple II greatly enhanced access times especially when used with a fixed disk. Mercury is also UNIQUE in the way in which programme development time can be substantially reduced using the full format screens available to create all the data entry, master file, display and print formats whilst still using Basic. So software development time is reduced to the bare minimum while the system operates with the speed of MERCURY.

SINGLE USER 5¼" FLOPPY	**£280**
SINGLE USER 20mb DISC	**£3930**
2 USER 20mb	**FROM £5285**
4 USER 20mb	**FROM £6245**
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Tel. 0481 - 20155 Telex 4191157 (INT MDA)

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SPECIAL TERMS AVAILABLE FOR GOVERNMENT AND EDUCATIONAL DEPARTMENTS.

WORDS ON WORDS ▶

Housed in a desk-top enclosure, the new stand-alone word processing system from DataText comes complete with 25x80 character screen, keyboard, control unit housing two quadruple density mini diskettes and proportional spacing printer. It will retail for £5,500. A similar system incorporating a 5M Winchester disc and a single mini diskette will sell for £8,500. Configured around an 8085 processor, the system is available with proven word processing software with maths and information retrieval. Sophisticated video enhancements such as blank, reverse, bold, underline and suppress are standard and the display can be in green, amber or white. Further enquiries should be directed to DataText, White Hart House, London Road, Blackwater, Camberley, Surrey or by telephone on 0276 32923.

AND FOR THE NEXT EPISODE...

Although measuring 7.5" high by 9.5" wide by 10.5" deep and weighing only 15lb, the Z80A – based Episode microcomputer has an integral storage capacity of up to 1.6M provided by two single or double sided and double or quad density 5.25" floppy disc drives. Episode also features two RS232C serial interfaces, a Centronics compatible parallel interface and a battery operated calendar clock. Claimed to work with virtually any VDU and printer, the Episode is offered with a suite of commercial software packages and, for the software writer, a wide range of high level languages including COBOL, BASIC, FORTRAN, Pascal and APL. Available as a stand-alone unit with 1.6M of storage, the Episode is priced at £1,999 plus VAT. Enquiries should be directed to Equinox Computers, 16, Anning Street, New Inn Yard, London EC2A 3HB or call them on 01-739 2387.

SOUND ADVICE

Following in-depth interviews with 100 directors, partners and managers of small companies all over the UK about their experiences with small computers – both micros and minis – all costing under £30,000, a research team from the University of Lancaster were able to assess the benefits and pitfalls of small computers. The ensuing report, including facts and figures culled from the various problems encountered by the interviewees, not only provides potential buyers with advice on hardware and software problems but is also intended for suppliers of small computer systems to help them understand their market better and thus improve their service. The report 'Small Computers in Small Companies' can be obtained for £25 from Marketing Consultancy Research Services, Department of Marketing, University of Lancaster, Lancaster LA1 4YX or by 'phoning them on 0524-65201.

OUT OF CONTROL

Designated the DCB4A, a double density disc controller board has been made available for S-50 bus systems. Able to operate with either the Motorola 6800 or the 6809 CPU, one DCB4A board allows control of up to four 5¼" discs and four 8" discs. Under software control, the user can select single or double sided operation, single or double recording density, stepping rate, and 40 track or 35 track density on 5¼" drives, for any drive. Occupying 16 bytes of memory space, the DCB4A can read and write a single sector by itself, allowing full interrupt capability in interrupt driven systems. Available from Windrush Micro Designs Ltd at a price of £279, further details can be obtained from them at Gaymer's Way Industrial Estate, North Walsham, Norfolk NR28 0AN or by telephone on 069240-5189.

BANZAI! ORIENTAL REVENGE?

Or rather, Bonsai. Anyway, Bonsai Ltd have introduced a desktop microcomputer, SM3000, that can act as a data processor, word processor or a modelling tool. Powered by a Z80 processor with 64K of dynamic RAM, the SM3000 can drive both high speed dot matrix and letter quality printers. The system can incorporate a wider range of peripherals including two mini-floppy discs, single and double sided 8" discs and fixed Winchester hard discs giving potential storage of up to 11M. The SM3000, priced from £2,750, is available together with a comprehensive range of financial/management software from Bonsai Ltd, 112-116, New Oxford Street, London WC1 or telephone for details on 01-580 0902. ▶

BUSINESS NEWS

THEY LIKE IT! ▶

Remember a couple of months back we told you about the Osborne 1, the portable businessperson's microcomputer system produced by Adam Osborne. Well if you found it impressive, you weren't the only ones. The Comart Group have recently decided to commit their resources to supporting the Osborne machine through their retail outlets, Byteshop Computerland and Xitan Systems Ltd. For further details, get in touch with The Byteshop Ltd, Little End Road, Eaton Socon, St Neots, Huntingdon, Cambridgeshire PE19 3JG or by 'phone on 0480-216610.

THE COMPLETE SPECTRUM

A new range of microcomputer systems have been introduced featuring the APL programming language. At the lower end of the range there is the MicroAPL SIG/NET, priced at around £1,300, featuring hardware based on the Z80 chip. Complete with 64K of memory, the SIG/NET includes a range of utility libraries and can be used to run the WORDSTAR word processing system as well as a selection of languages. The upper end of the range, priced at around £20,000, includes the Spectrum 16-bit machine, based on the Motorola 6800 chip. A multi-user system features APL workspaces in excess of 500K of directly addressable RAM, and a choice of either a 36M 8" Winchester hard disc unit or a 12M micro Winchester 5" hard disc. Further enquiries should be directed to MicroAPL Ltd, 19, Catherine Place, Victoria, London SW1E 6DX or by telephone on 01-834 2687/8.

OCCUPATIONAL THERAPY FOR TEACHERS

Two new systems have been introduced by Monroe Systems, the OC 8820 aimed at the small business microcomputer field and the OC 8800 developed to meet the maturing computer requirements of the secondary and post-secondary school levels. Both based on the Z80A and incorporating 128K of user RAM, double-density disc drives provide 650K storage capacity in the Occupational Computer, model OC 8820, and 330K capacity in the OC 8800. Both systems feature Monroe Extended BASIC and are supported by a full range of software packages. The standard OC 8820 unit is available at £2,990 and a basic model OC 8800 is priced at £2,450. Further details can be obtained from Ficord International Ltd, Didsbury, Manchester M20 0RD or by telephoning 061-445 7716.

VIDEO DUO

The VIO-X I/O interfaces for the S-100 bus, through the use of the Intel 8275 CRT controller with an on-board 8085 processor and 4K memory, operates independantly of the host system and communicates via two ports. The VIO-X1 provides an 80 character by 24 line format using a 7x9 dot matrix to display the full ASCII alphanumeric character set; an optional 2732 character generator is available which allows an alternate 7x9 contiguous graphics character set. The VIO-X2 offers an 80 character by 25 line format using a 9x9 dot matrix allowing high-resolution characters to be used. This model also includes expanded firmware for block mode editing. Prices for the VIO-X1 and VIO-X2 are £234 and £242 respectively. For more information on the VIO-X interfaces and details on the rest their catalogue of computer products, contact Fulcrum (Europe), Valley House, Purleigh, Essex CM3 6QH or telephone 0621 828763.

BLANKED OUT

In the space of five seconds all static and remnants of previous programs not fully erased by the recorder's erase heads can now be fully erased, at last eliminating those annoying SUM ERROR read outs. Using a Wiercliffe bulk eraser model 26, all 'C' format cassettes, including chrome and metal base, can be erased up to −90dB below a saturated 1kHz signal. The model 26 has the capacity to blank up to 60 cassettes an hour. Other units in the Wiercliffe range are designed specifically for audio tapes up to 16" in diameter and 2" video tapes for television and film studios; units that can erase up to 15,000 cassettes an hour. Remembering that even new tapes can benefit from erasing spurious noise and static picked up in transit and storage, it might be worth getting a little more information from Amos of Exeter Ltd, Wiercliffe House, Exwick, Exeter or on 0392-72132.

STAR QUALITY

Based on the NorthStar Horizon computer, the SuperStar desktop microcomputer system incorporates a 5¼" integral Winchester disc drive capable of up to 15M of storage capacity. Up to eight users can be accommodated in the SuperStar chassis, each user having a private processor card containing a Z80A processor, 64K of RAM and an RS232 port for the VDU. An expansion card can be added offering each user a private serial and parallel printer. The standard system has a 10M Winchester unit and a 400K floppy disc and is available at £3,995 for the single user, £5,995 for two users, £6,995 for three users and £7,995 for four users. For further details on the SuperStar system contact Bromley Computer Consultancy, 244A, High Street, Bromley, Kent BR1 1PQ or telephone 01-464 8080.

◀LINK IT!

Clearway node units have been designed to provide an economic routing system linking various computer equipment together. The system operates by individually connecting the terminals, computers and word processors to a single coaxial cable, identical to that used in radio and TV applications, via Clearway node units. This allows simultaneous communication between all the devices connected to the cable to take place. Available on a modular basis, each Clearway device will cost £100. For full details contact Richard Platts at Real Time Developments Ltd, Lynchford House, Lynchford Lane, Farnborough, Hants GU14 6JA or 'phone 0252-46213.

THREE PET TITLES from Nick Hampshire

LIBRARY OF PET SUBROUTINES

A book which will save the software designer considerable time by providing 55 proven subroutines to integrate with his own programmes.

Each subroutine is preceded by a page of general information describing its purpose and implementation and possible problems that may arise. Basic, machine language and a combination of both, are used throughout this publication.

". . . We like this book very much and thoroughly recommend it."
Printout

". . . well prepared, fun to use, and will help in better program development."
Compute

THE PET REVEALED

A reference book which details everything you need to know about the workings of the PET. Containing information helpful to writing more elaborate programmes, which in turn create more interesting functions.

". . . Should be congratulated. Supplies some much needed, useful and correct documentation."
Compute

". . . 'PET Revealed' will save you an awful lot of time. I rate this book as good value for money."
Printout

All 3 publications are widely used by Commodore Business Machines.

PET GRAPHICS

This book has two objectives. One, to provide the reader with an introduction to the programming techniques used to generate graphic displays. Two, providing the programmer with a complete package of machine code routines giving a wide range of normally unavailable graphic functions. The book contains many comprehensively analysed routines and photographs to illustrate the effects created.

". . . an invaluable guide to graphics on the PET."
Micro Forecast

Please send me:

..... copy/ies of Library of PET Subroutines @ 10.00 each

..... copy/ies of The PET Revealed @ £10.00 each

..... copy/ies of the New Edition of PET Graphics @ 10.00 each

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Make the most of your Sinclair ZX Computer...

Sinclair ZX software on cassette.

£3.95 per cassette.

The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.

Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

How to order

Simply use the order form below, and either enclose a cheque or give us the number of your Access, Barclaycard or Trustcard account. Please allow 28 days for delivery. 14-day money-back option.

sinclair

ZX SOFTWARE

Sinclair Research Ltd,
6 Kings Parade, Cambridge,
Cambs., CB2 1SN. Tel: 0276 66104.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. Please print
Please send me the items I have indicated below.

Qty	Code	Item	Item price	Total
	21	Cassette 1 – Games	£3.95	
	22	Cassette 2 – Junior Education	£3.95	
	23	Cassette 3 – Business and Household	£3.95	
	24	Cassette 4 – Games	£3.95	
	25	Cassette 5 – Junior Education	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
	18	*16K RAM pack for ZX81 and ZX80	£49.95	
		*Post and packing (if applicable)	£2.95	
			Total £	

*Please add £2.95 to total order value **only** if ordering ROM and/or RAM.

I enclose a cheque/PO to Sinclair Research Ltd for £_____

Please charge my Access*/Barclaycard/Trustcard no.

Please delete as applicable.

Name: Mr/Mrs/Miss _____

Address: _____

COT 03

NEXT MONTH

CONNECTIONS

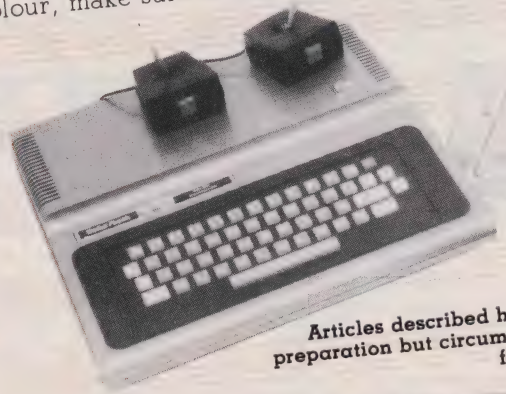
Adding peripherals to your computer is a subject we have covered from time to time over the last three years in practical terms but we have never really covered the technology itself. Well, this new series will soon put that to rights!

If you've always wanted to know what an A to D actually does or how to connect up a PIO, you had better book yourself a regular copy of CT because over the next few months we'll be revealing all this and much much more.

COLOUR CRAZY

More and more computer manufacturers are adding colour to their personal systems, be they domestic 'games systems' or serious programmers' tools. The amazing thing is not that they are fitting colour, but that the prices are so low. Even a couple of years ago systems offering colour were not only rare but very costly — today we can make our choice from some half-dozen systems — none of which cost more than £500.

The best way to see what the companies are offering is to take one away and try it out — so that's exactly what we've done. In next month's magazine we'll be looking at the re-launched TI system and Tandy's Color Computer so, if you are in the market for colour, make sure of your copy.



INTERPRETING

Every time you use BASIC on your computer you are using a special program called an Interpreter. You may never actually realise this (you certainly shouldn't if the system has been properly designed) but if you want to write fast BASIC programs you'll soon realise that something is slowing things down.

If you can't afford a compiler then you need to know how to get around some of the problems that an interpreter can cause. Next month we'll be taking the top off the ROMs and seeing just how an interpreter interprets.

THE VALLEY

One of the best ways to learn about programming is to try things out for yourself, but getting started is always the hardest part. In an attempt to demonstrate programming techniques and simultaneously provide a working program, we set to and wrote 'The Valley'.

After nearly a year of programming and testing we now proudly present a multi-system, totally modular, graphic adventure game. Why a game? Well, we thought you might like to enjoy the learning process so we selected the most popular type of game and then improved on all the current commercial programs. Each routine used within the game is fully documented and, once the programmer has mastered the way it operates, it can be modified or expanded to suit your personal tastes.

If you want to step into a top-class adventure game and learn about advanced programming techniques at the same time, you simply can't afford to miss the next issue.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

GIVE THIS TO YOUR NEWSAGENT

Please reserve me a copy of April's Computing Today

NAME .....

ADDRESS .....

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April Issue On Sale Friday March 12th

SOFT WARES

HOW TO LIVE WITH A CALCULATING PET

A compact yet powerful calculating program called SimpliCalc has been developed for Commodore PET machines and can even be driven by an 8K PET. Written in BASIC, SimpliCalc is a 134 line program that the designer stresses is not machine code VisiCalc re-written in BASIC. Claimed to be the ideal program for the small business or the busy executive with a PET at home, SimpliCalc is available in either cassette at £29.90 or on mini floppy disc priced at £39.80. SimpliCalc is now being developed for the VIC 20 and the Apple 2. Plans are also afoot to include programs for the Sinclair machines and the new BBC personal computer. Further information is available from Mark Turner, The Cronite Group Ltd, Montgomery Street, Birmingham B11 1DT or by telephone on 021-773 8281.

A RUSSIAN APPLE?

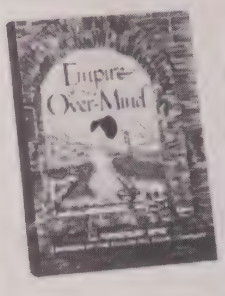
Four new disc packages are available for the Apple II under Applesoft BASIC, including a Russian package designed to teach students, business people and travellers to read and use the Russian language. Other new software packages include a record keeping and billing program for small- to medium-sized businesses called Client Record/Bill Preparation and a program called Jet fighter Pilot taking the user through a combat flying simulation. This latter program is also available as a TRS-80 cassette package. For further details contact Wayne Green Inc, Peterborough, NH 03458, USA or dial the code for America followed by 603-924-7296. Tell them we sent you!

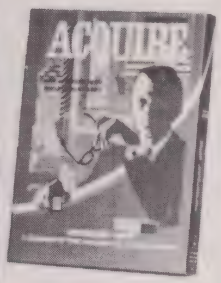
AND NEXT...

A program to take the drudgery out of program development. Called 'THE NEXT ONE', it has been designed to eliminate the need for the programmer to write and transfer all those subroutines from keyboard to disc and then back from disc to memory. The generated code is claimed to be structured; simple and flexible avoiding the need for the user to learn the 'language' of the program. 'THE NEXT ONE' is available in several versions in BASIC, compatible with the Apple II and the ITT 2020; there is also a version for CP/M-based systems. For information on 'THE NEXT ONE' and the rest of their large range of structural and engineering software, get in touch with Logical Computing, 26, Wide Lane, Swaythling, Southampton SO2 2HH or 'phone them on 0703-583857.

THE AVALON TAPES

Expanding their range of Microcomputer Games, Avalon Hill have introduced three new games programs on cassette written for the TRS-80, Apple, PET and the newer Atari microcomputers. The latest arrivals are 'Tanktics', a wargame simulation between Russian and German tanks; 'Acquire', taken from the board game about the intrigues of foreign finance; and lastly, 'Empire of the Over-Mind', an adventure game where the player proceeds through a number of puzzles to gain the prize at the end or perish in the attempt! Prices of the tapes are £15.95 for Tanktics, £12.95 for Acquire, and £18.95 for Empire of the Over-Mind. Details of the complete Microcomputer Games range are available from Avalon Hill UK Ltd, 650, High Road, North Finchley, London N12 0NL or telephone 01-445 3044.





TWO FOR ALPHATRONIC

A new micro business system, ALPHA ESTATES, has been especially developed for the administration of small and medium size estate agencies, a program based on the Triumph Adler Alphatronic machine. Complete with a twin disc system including VDU and printer, ALPHA ESTATES is priced at £2,870. There is also a selection of wordprocessing packages as well as a comprehensive library of accountancy packages, all priced at between £200-700. Further enquiries should be directed to Triumph Adler (UK) Ltd, 27, Goswell Road, London EC1M 7AJ or by telephone on 01-250 1717. And yet more software for the Alphatronic micro. A new release of Microtrend's Lexicom features fully automatic horizontal scrolling, integral screen calculator mode with automatic decimal point alignment, plus the ability to screen documents up to 200 characters wide. The new release is priced at £350 and users of earlier versions can obtain an upgrade kit for £75. For more details of the Lexicom/2 contact Microtrend Ltd, PO Box 51, Pateley Bridge, Nr Harrogate, N Yorkshire or telephone 0423-711878.

THE ATARI DOZEN

A range of software has been specifically developed by THORN EMI Video Programmes for the Atari 400 and 800 personal computers. Initially twelve titles will be available covering a wide range of family requirements, from home financial management to Jumbo Jet and submarine simulations, educational puzzles to eight-ball pool and numerous other games such as darts, billiards and snooker. All programs include a choice of variations and feature colour animation and graphics as well as sound effects and music. The new titles, priced between £14.95 and £29.95, are available through selected outlets of the TV rental companies: Radio Rentals, DER and Multi-Broadcast, as well as through Ingersoll Electronics' nationwide network of dealers. For further information contact Ingersoll Electronics Ltd, 202, New North Road, London N1 7BL or telephone 01-359 0161.

CLIVE'S GOT IT TAPED

Following the successful launch of six cassettes for the ZX81 back in September, 1981, ICL have launched two new software packages. The new cassettes, 1K and 16K in size, follow the same format as the previous six being a mixture of games, puzzles, housekeeping and educational programs. All eight cassettes in this range are priced at £4.95. For further details get in touch with Sinclair Research Ltd, 6, King's Parade, Cambridge CB2 1SN or telephone them on 0223-312919.

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★ **Housed in strong, stylish case with high quality QWERTY keyboard.**

★ **0.7Mbyte floppy disc system available in matching case.**

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Think of Nascom 3 as an advanced personal computer, built to professional standards and offering the total systems versatility needed by enthusiasts whose imaginations are already ahead of the toy computer field.

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Nascom 3; reliable, expandable, affordable – and backed by one of Britain's best known engineering groups. Think about it.

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★ Advanced video controller from £155 + VAT
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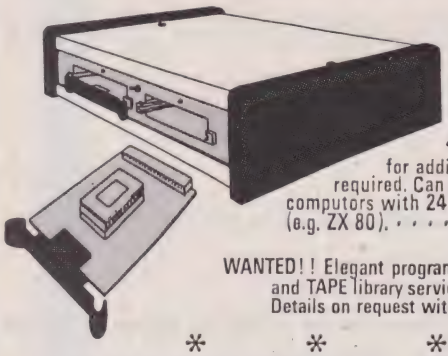

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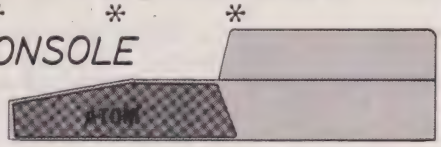

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THE ARGUS

Owen Bishop

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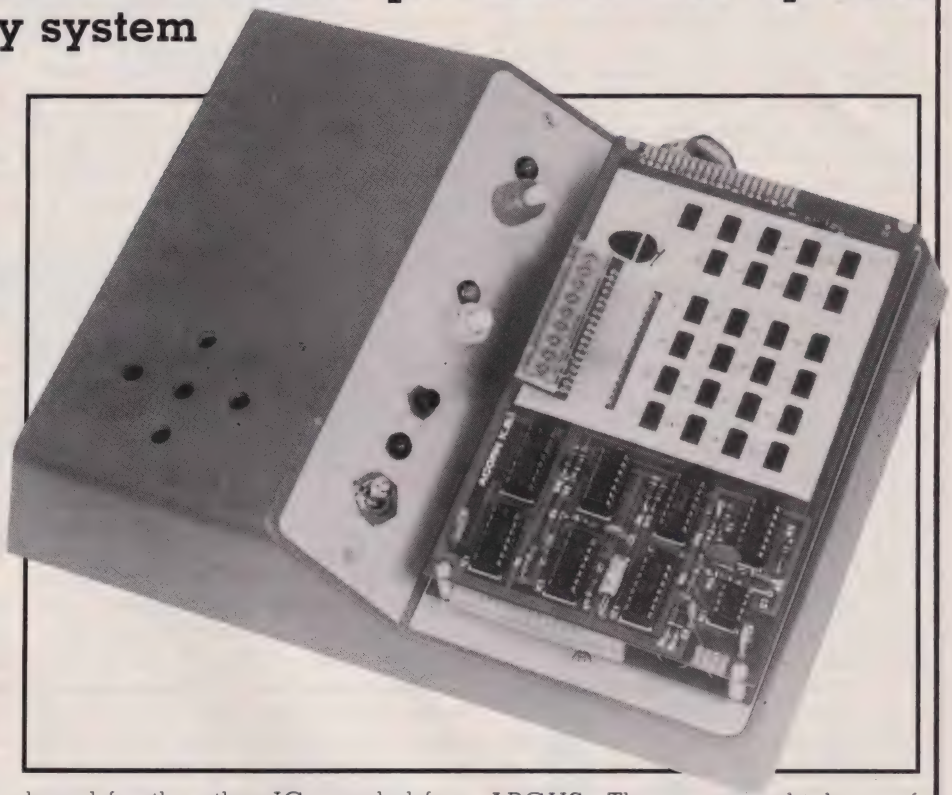


No, this is not an attempt by the author to ingratiate himself with the publishers of this magazine (Argus Specialist Publications Ltd) for, as the more classically-minded of our readers will know, the Argus was a fabulous creature with a hundred eyes, half of which were always awake. The task of the All-Seeing One was to watch over Io! With The ARGUS attached to your micro, and with the many interfaces from the MICROLINK series acting as its hundred eyes, you will have a warning system which, day and night, watches over your home and — incidentally — takes care of innumerable other aspects of running the house.

The Microlinks

Over the past two years, this series has presented many different interfaces to connect to your Mk-14 or Acorn System 1 microcomputer. We now show how many of these interfaces may be connected to one computer as the components of a unified alarm system. Systems for other purposes could have been devised but, on looking through the previous parts of the series, it seemed that a warning system would bring together the various interfaces in the most practical and useful way. The principles explained in this article will allow you to design systems for other purposes; should security not be your main concern. Readers who have already built the earlier interfaces will be able to connect them directly to this system, except for the light-operated switch (CT, March 1980) which needs some additional circuitry (to be described later).

The ARGUS can deal with all these interfaces and several more; the complete system being complex to program and taking many hours to construct. However, to make it easier for you to begin, The ARGUS has been designed to be implemented in two phases. Phase 1 will incorporate a useful selection of facilities — enough to protect the house against intruders and to do plenty of other things as well; even at this stage you do not need to bring every section into action. After Phase 1 has been installed there is enough room left on the board for the other ICs needed for Phase 2; you can add these stage by stage, gradually expanding to the complete system.

The ARGUS In Outline

Figure 1 shows the configuration of the system. As with all the MICROLINK interfaces, the ARGUS interface connects to the input/output IC of the computer — usually an INS8154. The system was designed to use only Port B, leaving Port A completely free for attaching other interfaces or systems which can be used at the same time as The ARGUS. This gives eight lines of Port B to link The ARGUS to the micro, plus one or two interrupt lines. Like many micros Acorn has NMI (non-maskable interrupt) and IRQ (interrupt request) lines, giving two levels of priority in interrupting. The Mk-14 has only one level, a high level (INT) at the SENSE-A input.

Lines B0 to B3 of Port B are used as a four-bit data bus. Data is transferred between the interface and the micro on these lines. The other four lines (B4-B7) are used to route the data to the correct destination or acquire it from the ap-

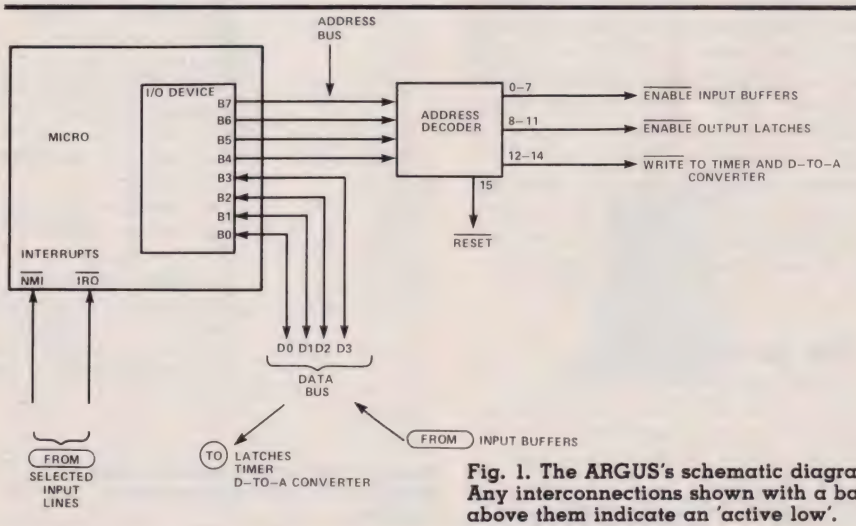


Fig. 1. The ARGUS's schematic diagram. Any interconnections shown with a bar above them indicate an 'active low'.

propriate source. An address decoding circuit accepts the four-bit address. If the address is between 0 and 7, it enables one of eight sets of input buffers. These buffers are receiving signals from various peripherals such as pressure mats or a light-operated switch. When a set of buffers is enabled, each of the four buffers in that set puts its data onto the four data lines. The micro now reads this data.

In the case of those peripherals which are part of the intruder detection system, for example, the output from each device is normally high but goes low when triggered by an intruder, thus causing an interrupt.

The micro might be engaged in playing 'Moon Landing' at the time but will immediately skip to its interrupt routine enabling each input buffer in turn to find out which peripheral is causing the interrupt. It then takes appropriate action and, if the action is something which need not concern you, returns you to land on the Moon as if nothing had happened.

Certain peripherals, such as the sound-operated switch (CT, May 1980), have an output which goes low and stays low until the switch is reset. Other peripherals generate only a transient low pulse which the micro may miss — one example being a pressure mat, its output is low only while it is being stepped on. These transient outputs are fed to bistables which are triggered by the low pulse and stay set until reset by the system.

Addresses 8 to 14 are concerned with outputs. Addresses 8 to 11 cause data to be transferred to one of four sets of latches which hold the data until the micro changes it. This data is then fed to peripherals such as the audible warning devices, switching them on and off, or controlling the kind of sound they make. Addresses 12-14 cause data to be transferred directly to peripherals which are able to store the data for themselves. An example of this is the Alarm Clock timer (CT, February 1981). Finally, the address 15 causes a RESET pulse to be sent to the bistables and devices which need to be reset (except the timer which has a separate reset line).

The Ins And Outs

Table 1 shows the full range of inputs to The ARGUS. LOOP is a peripheral loop of wire running to all doors and windows which are to be protected. Each has a mechanical or magnetic switch which is closed when the door or window is closed. When any door or window is opened, the continuity of the loop is broken and the alarm is sounded. Windows may also have strips of conductive window foil fixed to the glass, warning being given when the glass is broken by an intruder. Details for installing a peripheral loop can be found in **Projects for Home Security** (Newnes-Butterworth 1981). MATS refers to one or more pressure mats which may be placed on the stairs, in front of a safe or anywhere else the intruder is likely to step. A pressure mat is a normally-open switch and contact is made when the mat is stepped on. EXIT is a normally-closed switch on the exit door. This is the door by which you leave the house when it is left unoccupied. The micro is programmed to allow you (say) 20 seconds to leave by this door after you have turned on the alarm system. Provided you leave before 20 seconds has elapsed, the exit door may be opened and shut again without setting off the alarm. When you come home again, the micro allows you 20 seconds in which to open the exit door and disable the alarm. If the system is not disabled within 20 seconds, the alarm sounds. GAS is the Gas/Smoke detector (CT, October 1980) used to detect fire or to warn of the risk of fire because of inflammable vapours. EM1 and EM2 are two Emergency Buttons placed at strategic points in the house, allowing the occupants to trigger the alarm manually. OUT is a button on the console which is pressed whenever the house is to be left unoccupied initiating the time delay on the exit door. This is programmed to have toggle action; it also duplicates as the EXIT switch.

TIMER is the output of the Alarm Clock Timer, which goes low when the pre-set period of time has elapsed. The next three inputs are self-explanatory, except that the sound-operated switch (BABY) could be used to listen for intruders instead. RAIN is a peripheral (to be described later) which detects rain; an eye for The ARGUS to use on wash-days! It can also detect an overflowing cistern, bath, or any other kind of flooding. The DOOR inputs come from ordinary push-buttons, bringing your doorbells under the ARGUS's control.

The two THERMOFACE inputs do not cause interrupts but are read by the micro as required.

This allows the system to monitor temperature (in the living-room for example) from time to time. For detecting fire it is better to use a simple thermistor-activated trigger circuit (see the book referred to above) with its input wired so as to cause an interrupt. There are two spare input addresses, one of which can be used for this. The two THERMOFACE inputs each provide one byte of input, taken four bits (high and low) at a time. Any other pair of eight-bit analogue-to-digital inputs could be read instead. A real-time clock could communicate time and date to the micro through one of these channels.

Name	Function	Interrupt	Bistable	Phase
LOOP	Peripheral loop (NC)	NMI	*	1
MAT	Pressure mats (NO)	NMI	*	1
EXIT	Exit door switch (NC)	NMI	*	1
GAS	Gas or smoke detector	NMI	*	2
EM1	Emergency button 1	NMI	*	2
EM2	Emergency button 2	NMI	*	2
OUT	Press button when house left unoccupied (toggle action)	NMI		1
TIMER	Microlink alarm timer	IRQ		1
SECURE	Disable/Enable security (toggle action)	NMI		1
LIGHT	Light sensor	IRQ		1
BABY	Baby alarm or sound-operated switch	IRQ		2
RAIN	Rain-operated alarm	IRQ		1
DOOR A	Door alert (front door)	IRQ		2
DOOR B	Door alert (back door)	IRQ		2
THERMOFACE 1	Temperature measurement (eg central heating or fire hazard)			2
THERMOFACE 2	Temperature measurement (eg greenhouse, frost), or a Real-Time Clock			2
SPARE		IRQ		2
SPARE		IRQ		2

Table 1. The various inputs to The ARGUS with their corresponding functions.

	Decoder lines	Data lines D3	D2	D1	D0
INPUTS	EI0	GAS	EXIT	MATS	LOOP
	EI1	TIMER	OUT	EM 2	EM 2
	EI2	RAIN	BABY	LIGHT	SECURE
	EI3	Spare	Spare	DOOR B	DOOR A
	EI4	THERMOFACE 1 — HI			
	EI5	THERMOFACE 1 — LO			
	EI6	THERMOFACE 2 or Real-time Clock — HI			
	EI7	THERMOFACE 2 or Real-time Clock — LO			
OUTPUTS	EO8	Relay 4	Relay 3	Relay 2	Relay 1
	EO9	Two-tone alarm		1-tone	Timer
		Pitch	On/Off	On/Off	reset
	EO10	Spare	Multiple-tone alarm		
			Rate	Pitch	On/Off
	EO11	Spare	LED 2	LED 1 (Alarm status)	
				Green	Red
	W12	Time code on data lines			
	W13	D-to-A code HI on data lines			
	W14	D-to-A code LO on data lines			
	RESET	Resets bistables, light sensor, etc.			

EIX = enable input X
EOX = enable output X
WX = write to device X
▒ = Phase 1

Alarming Noises

The latched outputs (addresses 8 to 11) activate a number of transistors. Four of these outputs drive relays (Table 2) and are used for switching external devices. In the author's system, one relay switches on the porch light at dusk each day and turns it off about four hours later. The relays may be used for switching room lighting, the radio or TV or even a vacuum cleaner, giving the appearance that the house is occupied while you are out for the evening or away on holiday. You can program the micro to follow different schedules on different days so that an observer will be even more likely to assume that you are always at home. You could also use the relays to switch on a radio and a tape recorder to tape broadcasts while you are out.

The ARGUS can also sound three or more different alarms, according to the nature of the occasion. The loudest is the multi-tone alarm and can be made to emit nine different tones but the four tones provided are generally enough. These can signal 'Intruders!', 'Fire!', 'Flood!' or whatever other disaster is likely to strike your home. The two-tone alarm is suitable for a baby alarm, rain alarm or for the door bells. It can also be used to sound a frost warning. By programming a suitable sequence of high and low tones, a wide variety of signals can be generated. The single tone alarm is a solid-state buzzer, emitting a low-level sound. It could be placed at the bedside to act as a baby alarm without waking up the rest of the household, or to wake you in time for the early morning cup of tea (the micro being programmed to switch on the electric kettle a few minutes earlier). If you need more alarms, there are two spare output addresses.

The LEDs serve as status indicators. LED1 is a multi-colour device which has a red LED and a green LED in the same package. It is used to indicate the status of the security alarm system (LOOP, MAT and EXIT). Four states are possible:

Both off	No light	Power failure has inactivated the system.
Green on	GREEN	System disabled (by pressing SECURE).
Red on	RED	System enabled (by pressing SECURE again).
Green & red on	YELLOW	System enabled except for exit door (by pressing OUT).

LED2 may be used for indicating the status of any other program or system.

Address 12 is used to tell the Alarm Clock timer that a new time code is on the data lines. When the address lines are set to '12', line (W12) goes low causing the timer to store the time code. The latches of the times are then reset by a high pulse on the 'Timer Reset' line so that timing begins from zero. W13 and W14 can then be used to control a digital-to-analogue converter, such as the ZN425E. This was used in the sound-generator interface (CT, August 1980), which can be used to provide a musical doorbell (different types for different doors) or early-morning alarm. To function with The ARGUS it needs two extra latches to accept and store the required eight bits, four at a time.

Circuit Details

Figure 2 shows the layout of the logic board. The prototype was built on the single-height low-cost Microboard, manufactured by Vero Electronics. The board has an edge-connector at either end, each consisting of 32 pads shaped and perforated as in Fig. 3. PCB plugs of the

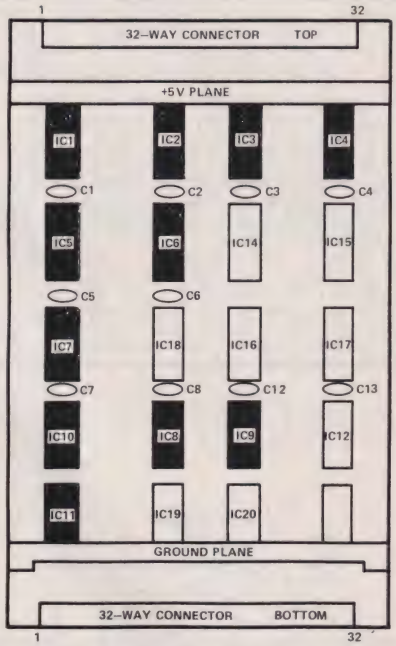


Fig. 2. The Microboard layout. Shaded devices are required for Phase 1, the rest belong to Phase 2.

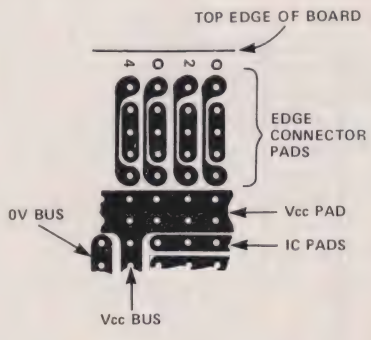


Fig. 3. A detail from the edge connector pads on the Microboard.

kind previously used in this series were soldered to pads 1 to 13 at the top of the board. One 10-way plug and one 3-way plug gave the required 12 lines and one spare (Table 3). Conventional indirect connectors could have been used for the other connections to the board but it was found to be simpler to solder 2.5 mm terminal pins in the pads making sure that both sections of the pad were joined by a bridge of solder. The allocation of pads is given in Tables 4 and 5.

Figure 4 shows the connections to the two 74LS138 decoder ICs. In each case, the most significant bit (B7) enables or disables the ICs, while the lower three bits (B4 to B6) are decoded as inputs A, B and C. IC1 is enabled by low inputs to its EN terminals when any address in the range 0 to 7 (0000 to 0111) is on the address bus. Its EN input is held high. IC2 is enabled when its EN input is made high by the presence of addresses 8 to 15 (1000 to 1111) on the bus. All outputs from these devices are normally high except for the one which is currently being decoded. Pin 7 of IC2 provides the general RESET output when address 15 is on the bus.

Six input buffers are contained in each 74LS367 IC (IC3, 4). Four buffers are enabled by a low input to pin 1 which is controlled by EI0 (IC3) or EI2 (IC4). Line EI1 goes to pin 15 of each, enabling two buffers in IC3 and two in IC4. Inputs to the buffers come directly from the peripherals or by way of the bistable (Fig. 6) as indicated. The two ICs provide for 12 inputs but only eight are to be implemented at Phase 1; unused inputs must be tied to V_{cc}. The output of each buffer is taken to the appropriate data bus. Four data bus wires are run around the board, each going to:

(a) the four data pins on the socket from the micro (Table 3).

(b) the pins on the buffers.

(c) the pins on the output latches.

Pin	Function
1	0 V rail
2	Line B0
3	Line B1 — Data bus
4	Line B2
5	Not used (is the +5 V line in other Microlink projects, but The ARGUS has its own +5 V supply.
6	Line B3 — Data bus
7	Line B4
8	Line B5 — Address bus
9	Line B6
10	Line B7
11	NMI
12	IRQ
13	Spare — possibly to Port A

Table 3. Interconnections to the micro from the top edge of the ARGUS board.

Pin	Function
23	0 V
24	D0 (=B0)
25	D1 (=B1)
26	D2 (=B2) — Data bus
27	D3 (=B3)
28	RESET
29	Time code (W12)
30	D-to-A HI (W13)
31	D-to-A LO (W14)
32	+5 V

Table 4. The outputs from the board. These communicate with the Alarm Clock timer and one D-to-A device. The timer also requires Reset and output lines, see Table 5.

Pin	Function
1	LOOP
2	MAT
3	EXIT
4	GAS
5	EM1
6	EM2
7	OUT
8	TIMER output
9	SECURE
10	LIGHT
11	BABY
12	RAIN
13	DOOR A
14	DOOR B
15	Spare
16	Spare
17	Relay 1
18	Relay 2
19	Relay 3
20	Relay 4
21	TIMER reset
22	1-tone alarm On/Off
23	2-tone alarm On/Off
24	3-tone alarm Pitch
25	Multi-tone alarm On/Off
26	Multi-tone alarm Pitch
27	Multi-tone alarm Rate
28	Spare
29	LED1 Red
30	LED1 Green
31	LED2
32	Spare

Table 5. Connections made from the lower edge of the ARGUS board.

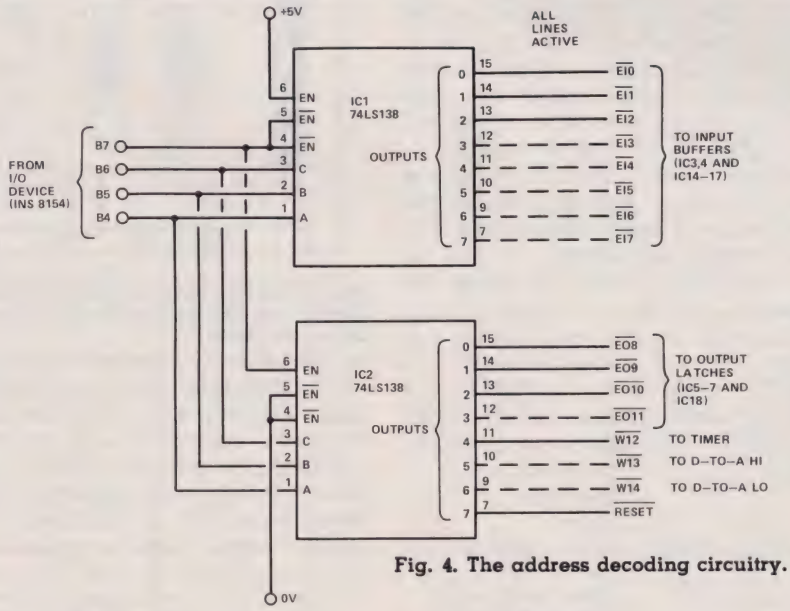
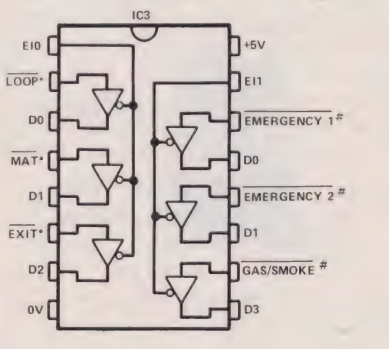
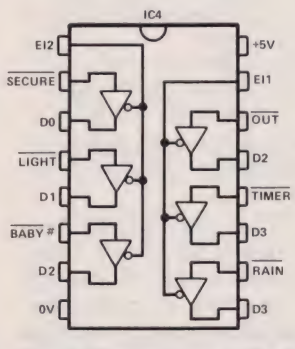


Fig. 4. The address decoding circuitry.





* VIA BISTABLE (IC8,IC9)
# NOT IMPLEMENTED IN PHASE 1; CONNECT TO +5V

Fig. 5. Connections to the input buffers for Phase 1.

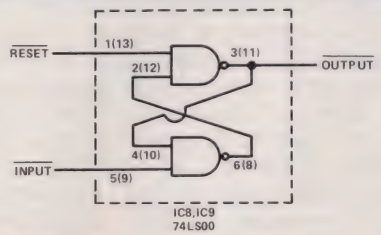


Fig. 6. Bistable connections, the bracketed figures refer to the second pair of devices in each chip.

(d) the pins on the top edge connector (Table 4).

It is strongly advised that a differently coloured wire be used for each data line so that faults may be quickly traced.

Those peripherals which are to cause an interrupt (as opposed to those whose output is read whenever the micro decides to do so) send their output both to the input buffers (direct or via a bistable) and to the NAND gates in ICs 10 and 11. In Phase 1 we have only eight interrupt lines to consider, unused inputs are wired to V_{cc} (Fig. 7). Their output is inverted by IC12 so the interrupt output that is normally high, goes low on interrupt. This occurs when any one (or more) of the peripherals signal an interrupt by a falling output. The Mk-14 has only one level of interrupt and this is active-high. At Phase 1 the output of the single NAND gate is used without inversion (Fig. 8a). At Phase 2 the combined outputs are NORed and then inverted (Fig. 8b).

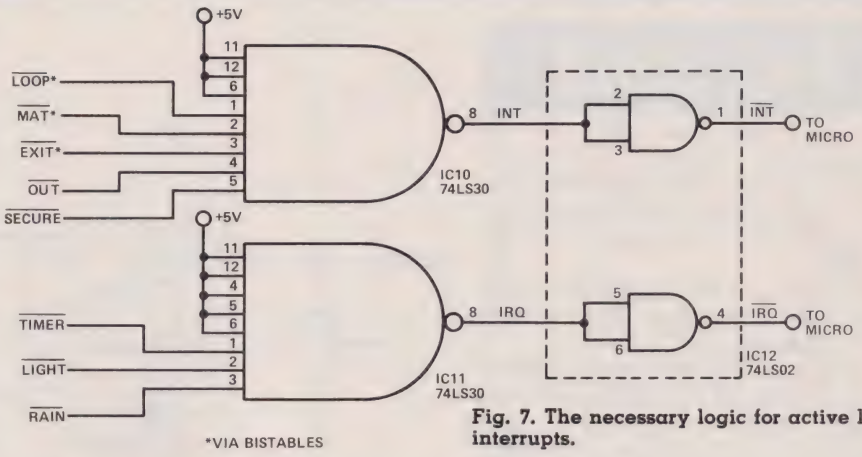


Fig. 7. The necessary logic for active low interrupts.

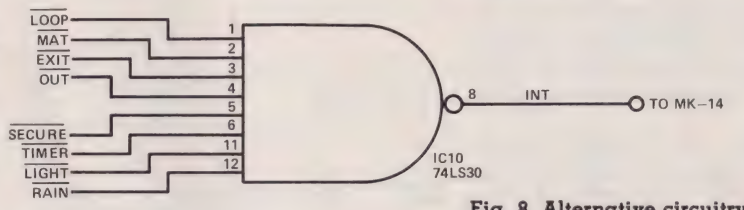
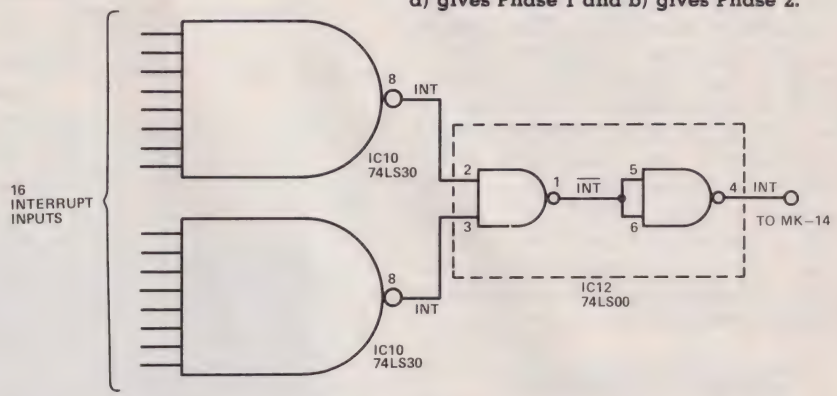


Fig. 8. Alternative circuitry for active high interrupts as used on the Mk-14. a) gives Phase 1 and b) gives Phase 2.



Input Peripherals

The circuit for a normally-closed loop system is given in Fig. 9. Switches are placed at every window and doorway on the ground floor and, possibly, at windows on the upper floors too. The exit door has its own separate loop with just one switch. Ouput from the main circuit is normally held high, but is pulled down by the resistor when any switch is opened. The capacitor C is optional, depending on the layout and size of the loop. It may be found that transient pulses appear on the loop, picked up from the mains circuit. These may be sufficient to trigger the alarm. The capacitor absorbs such pulses and is best mounted at the socket where the loop wire enters the case.

Several pressure mats may be wired in parallel, as shown in Fig. 10. Output to the system is normally held high by the resistor but goes low when any mat is stepped on. The OUT and SECURITY buttons are wired in the same way, as normally-open switches. Each requires its own separate connection to the system since each has its own address. Note that the input from pressure mats goes to a bistable since an intruder may step on the mat for only a short time. This would trigger the interrupt but, without the bistable, the micro might not have time to find out the cause. The OUT and SECURITY buttons are to be held pressed down until The ARGUS responds and indicates its response by a change in colour of the status lamp, LED1. No bistable is needed; the wires go directly to the buffers and the interrupt logic gate.

The output from the gas sensor changes slowly, giving the micro plenty of time to scan the inputs to detect its state; there is no need to route its input via a bistable. Use the '6502' output (CT, October 1980) with one of the transistors and since this output is not going direct to the micro, wire a 10k pull-up resistor between points B35 and 035 on the circuit-board.

The emergency buttons are better provided with bistables allowing the briefest touch to sound the alarm. For economy, these could be wired in parallel with the pressure mats, although there is the disad-

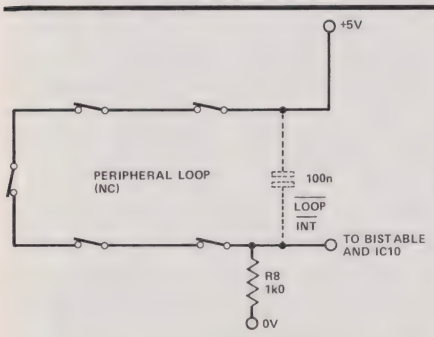


Fig. 9. A loop circuit for door and window switches.

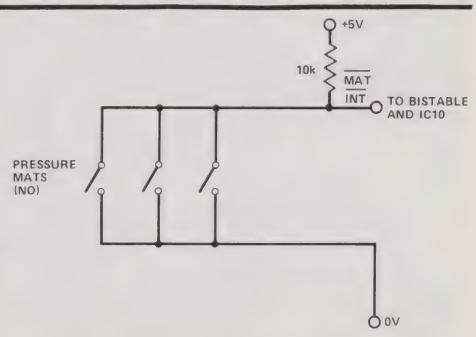


Fig. 10. Parallel wiring will suffice for pressure mats.

vantage that the micro would not be able to distinguish the exact source of danger. The remaining inputs, except for DOOR A and B, remain low until they are reset, so no bistables are needed. Callers normally press the doorbell button long enough for the micro to respond and so again, we do not need a bistable for these.

The output of the Alarm Clock should be taken from pin 1 of IC5 (CT, February 1981).

A simple RAIN or flood sensor is shown in Fig. 11. The probe consists of two bare wires placed close together but not touching; another idea is to use alternate strips of a small piece of stripboard. Output goes low when the gap between the probe wires or strips is bridged by water.

The RAIN and LIGHT probes come into a different category than those of the other input circuits. The micro needs to be informed when their output ***changes*** from high to low or from low to high. The devices should cause an interrupt when it starts to rain, when it stops raining, at dusk or at dawn. The circuit in Fig. 11 responds to changes of input and sends a low interrupt signal to the micro. This stays low until the circuit is reset. The micro cannot tell if the sensor itself has high or low output, so programming will have to allow for careful recording of the changes.

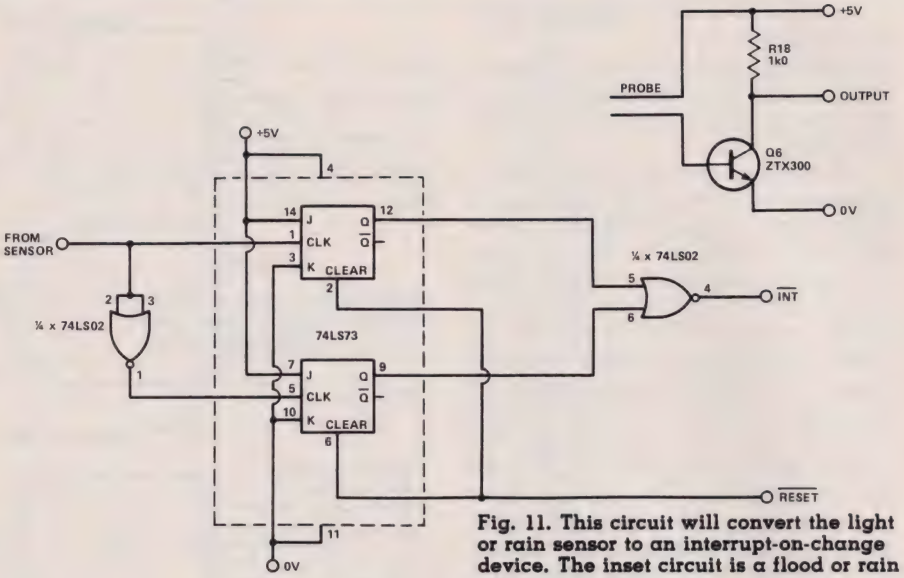


Fig. 11. This circuit will convert the light or rain sensor to an interrupt-on-change device. The inset circuit is a flood or rain sensor.

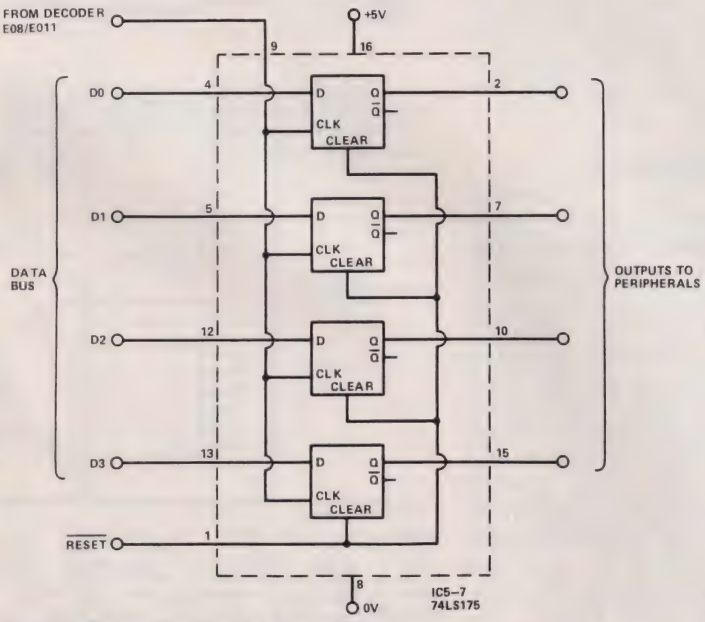


Fig. 12. Output latches for controlling relays, alarms or LEDs.

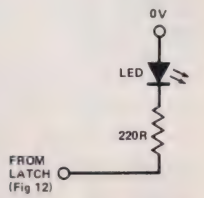


Fig. 13. An LED driving circuit.

Output Peripherals

Data for the Alarm Clock Timer and any digital-to-analogue converters go direct to these devices on the data lines. Active-low WRITE signals on lines W12 to W14 tell these devices when the data lines carry information which is to be stored. A low level on W12, for example, tells the timer that the data lines are carrying the new time code. W12 is connected to the 'Store' input (see the original article).

The remaining outputs are all latched on D-type flip-flops. There are 16 of these, four in each 74LS175 (Fig. 12). Their outputs normally remain unchanged whatever happens at their data inputs. When the clock changes from high to low, the Q outputs are set to the level held by each data input at that instant. A low on reset makes all Q outputs go low whatever the state of the clock. The sequence for outputting data is: start with clock high; put data on data lines; make clock low; then high. Data can then be changed without affecting outputs. Four latches are required for Phase 2, but at Phase 1 there are 12 output lines and so only three are needed. If you think it unlikely that you will be expanding to Phase 2, the addresses of Relay 3 and Relay 4 (Table 2) can be allocated for LED1. The spare address at E010 Hex can be used for LED2. This leaves E011 Hex unused and the corresponding latch (IC18) need not be fitted.

Driving The Peripherals

TIMER reset, the pitch and rate controls of the audible alarm devices, the LEDs, the coded outputs to TIMER and the D-to-A converter and the RESET line, are all wired directly from the Q output of the latches. Note that the LED is ***lit*** when the latch output is ***high*** (Fig. 13), and vice versa. The relays are each driven by a transistor (Fig. 14). The diode is essential to protect the transistor from the effects of induced back EMF — most DIL reed relays have such a diode built-in. The load switched by the relay can take its power from any DC source up to 100 V and carry up to 0.5 A. The current need not be returned to the 0 V rail of the system.

It is feasible to use the transistor to drive a heavy-duty relay to switch mains-powered devices. However, it is suggested that such relays should be switched by a DIL relay, using the unregulated 12 V supply to do so. The mains-switching relays

could be situated outside the system at or near the mains plug, or even inside the equipment to be controlled. The advantage of this is that mains wiring is kept clear of the system. Another advantage is that the connection between the system and the controlled equipment is by bell-wire carrying only 12 V. This makes it much cheaper and safer to control equipment which is situated in distant parts of the house. Several mains-switching relays can be controlled from one DIL relay so that, for example, lights in several rooms as well as the porch light can all be controlled by a single relay.

Audible warning devices are switched on and off by a transistor as in Fig. 15. Their other control signals (if any) come direct from the latches.

Next Month

In the next episode we'll concentrate on the remaining constructional details and the programming and testing of the system. We'll also take a look at how The ARGUS can be implemented in the domestic environment.

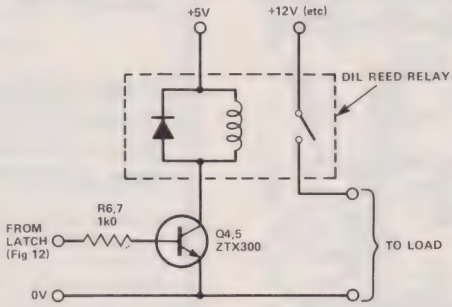


Fig. 14. The circuit required to drive a relay.

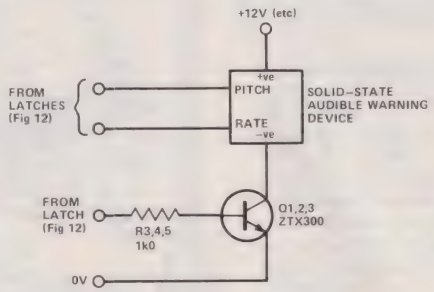
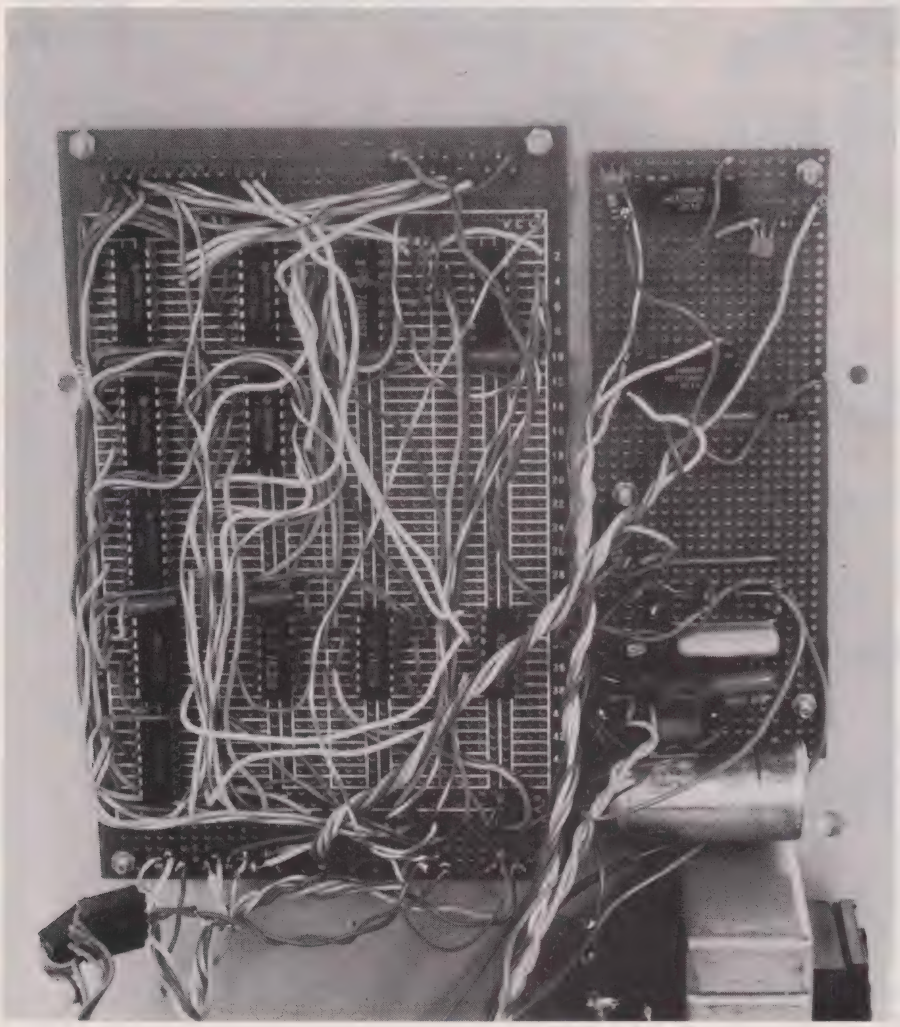


Fig. 15. How to drive an Audible Warning Device.



The internal wiring of the prototype system. The left-hand board contains the main logic and that on the right the drivers and relays. There is room for a further board, the Alarm Clock Microlink is one suggestion.

Parts List

Resistors All ¼W 5% unless otherwise specified

R1,2	220R
R3-9	1k0
R10-12	10k
R13	680R
R14	270R
R15	3R3 2W5 wirewound
R16	1R0 2W5 wirewound
R17	4k7

Capacitors

C1-8	100n polyester decoupling
C9	4700u electrolytic 16 V
C10	220n polyester
C11	470n polyester

Semiconductors

IC1,2	74LS138
IC3,4	74LS367
IC5-7	74LS175
IC8,9	74LS00
IC10,11	74LS30 (IC11 not needed at Phase 1 for Mk-14)
IC12	74LS02
IC13	7805 regulator
SCR1	C106 thyristor
Q1-5	ZTX300
LED1	LD100 tri-colour
LED2,3	TIL209
BR1	2A Bridge rectifier

Miscellaneous
Microboard single Eurocard (Vero 200-222-71B)
Veroboard 18 rows of 50 holes
Vero Hi Style Desktop console
1 mm plugs and sockets
10-way PCB plug and socket
3-way PCB plug and socket
DIL reed relays to suit
12 V 20 VA transformer
Toggle switches and push button switches to suit

Additional components for Phase 2

Resistors

R18-21	1k0

Capacitors

C12-14	100n polyester

Semiconductors

IC14-17	74LS367
IC18	74LS175
IC19,20	74LS00
Q6-9	ZTX300

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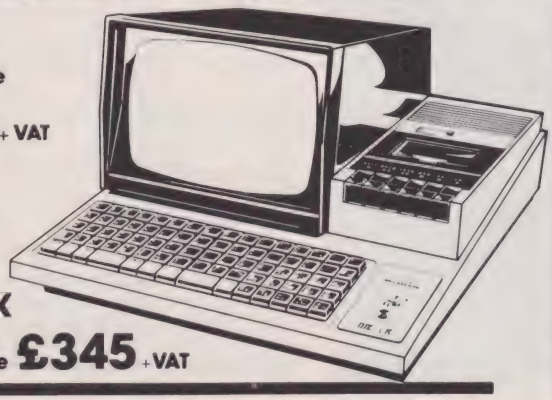

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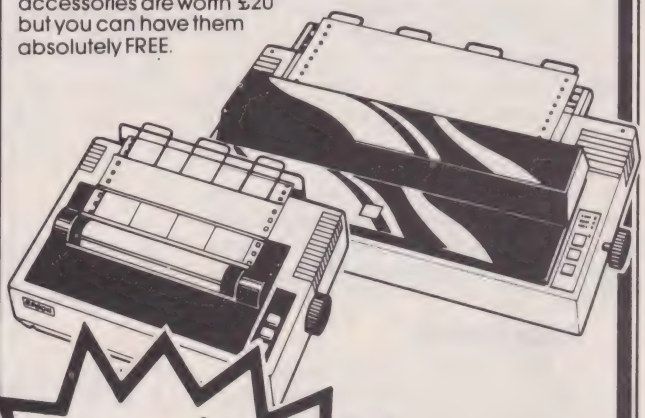

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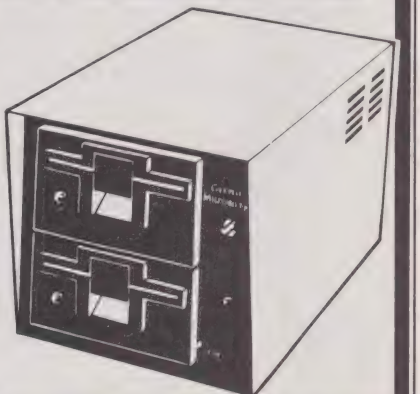

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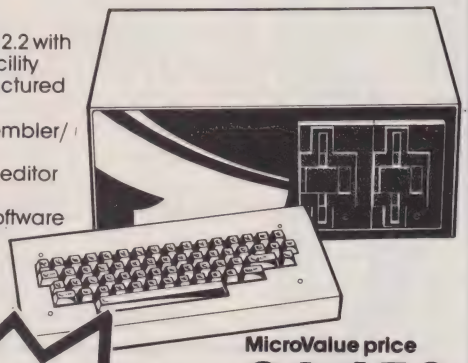

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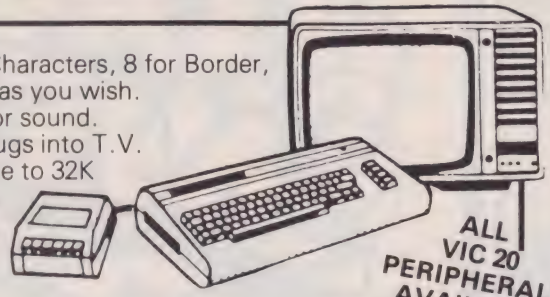

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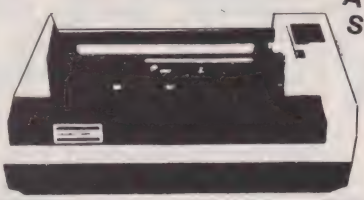

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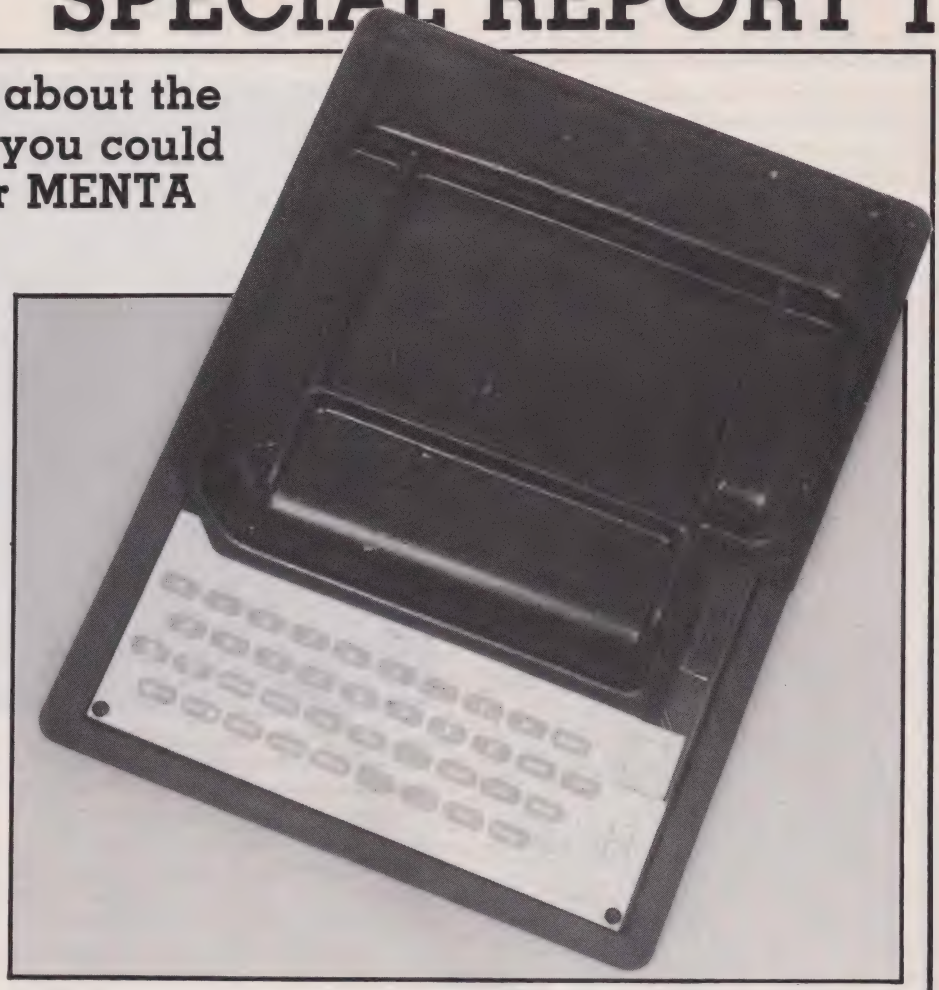
Access

Ian Sinclair

If you need advice about the Z80 processor then you could always turn to your MENTA



You might think that there wasn't much scope left for devising and producing yet another microprocessor assessment unit but when you look at what is available nowadays, you find surprisingly little that suits either the educational or the industrial user. However a new unit called MENTA looks like it will fill that gap very well.

The User Environment

The main handicaps of teaching and using so much of the existing microprocessor assessment equipment are firstly; that most of them use the 6502, which is not commonly used for machine-control and secondly; that all of them use hexadecimal entry. Entering machine code to a system in Hex is a tedious business and mistakes are very easy to make. Conventionally, the user of a microprocessor assessment system enters a starting address in Hex. He must then convert each instruction of the proposed program (which started life as assembly language) into Hex code, looking up each value in the instruction set for the particular microprocessor being used. This is a desperately slow business and has been a factor which has favoured the use of microprocessors with comparatively small instruction sets — such as the 6502 — rather than those with large instruction sets, like the Z80. In addition, when you have entered a program by such a method, it is not easy to edit. In particular, no additional code can be entered in the middle of the program without re-entering all the code which follows into a new set of addresses. This is because there is no INSERT command which will shift code to make room for new code. Another deficiency of the traditional type of assessment unit is its seven-segment LED display, which only permits one memory address and its data content to be displayed in Hex at any time. This makes checking a program a very tedious and eye-straining business; it is easy to get lost or to be unaware of whether the code you are looking at is the start of an instruction or a byte of data associated with an instruction.

The de-luxe end of the market can, of course, use a computer with an assembler program, so that programs written in assembly language can be typed in and assembled and the assembled code placed in memory or recorded on tape, or both. This has been the method traditionally employed where mainframe computers were available and has been successfully used with microcomputers. An outstanding example (for the Z80) is the ZEN program which is available for NASCOM, Sharp and TRS-80 computers; and (for the 6502) the Acorn computers have gone one better by having an assembler built in.

MENTA is — unlike its few competitors — Z80 — based and provides direct entry in assembly language but with less typing effort than is needed to enter assembly language into a computer. Instead of using an LED display of address and memory, MENTA plugs into a standard TV set to show 256 bytes of memory contents in a single display. This abolishes the need for painful single-stepping through a program and looking at each byte, because most of the programs used in education or development can be seen on the screen at a single glance.

The type of entry system used on the ZX81 computer has been put to rather better use here to make over 90% of all Z80 assembler commands capable of direct entry. Only a few of the commands — those that are not in common use — have to be entered in Hex code, so that for educational purposes it is, to all intents and purposes, a complete assembler system with a simpler method of entry than traditional assemblers. The code created by each command is shown on the TV screen with a flashing cursor to indictate the part just written, and more important, a highlight on the first byte of each instruction.

What's In The Box?

MENTA consists of a small case, moulded in ABS, a little larger than the ZX81. There is a touch-sensitive keypad and a small loudspeaker which bleeps each time a key is correctly pressed so that you can be sure when a keystroke is effective — this makes up for the lack of feel in the keys. If an illegal entry is made, the bleep is longer and nothing is entered. There are 40 keypads in all and a single seven-segment display is placed at the right hand side of the keyboard. This does not show

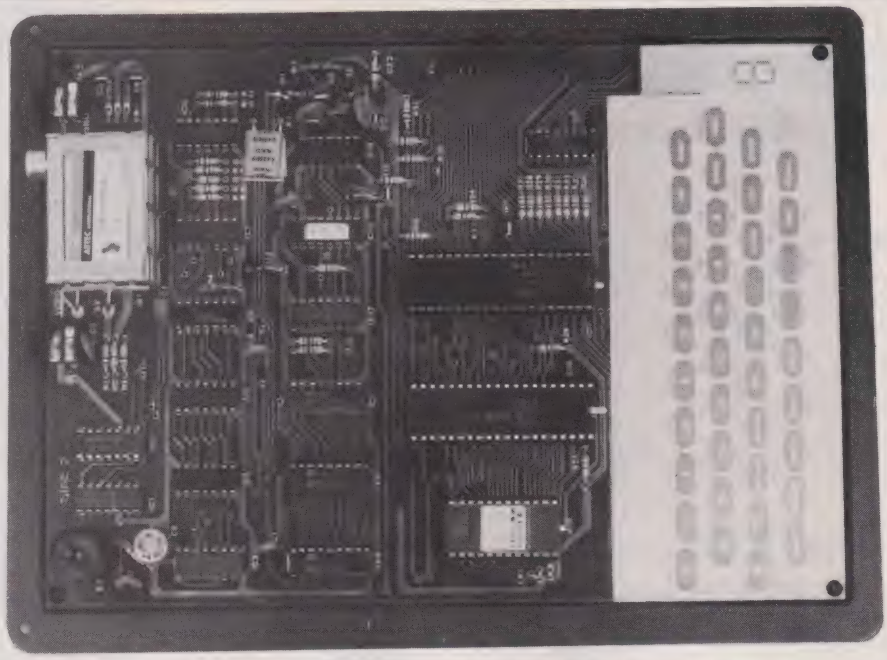
code, it is only a guide to how many pages of memory (four in all) are in use and to what type of entry is expected next.

The keys are multi-function, but there is never any need to use a SHIFT key to obtain the extra functions or to keep thumbing through a manual to find what you are supposed to press next. The legends printed on the keypads relate to their action when the machine is being used (which isn't often) to enter Hex code directly; the functions above and below the keypads relate to assembler actions. One of the attractions of MENTA is that it takes very little time to learn to use it. There is nothing so off-putting for a beginner as a piece of equipment which needs a six-week learning course; some assessment units I have used come perilously close to that.

At the back of the case are three sockets. One is for the power supply that comes from a small transformer-rectifier unit built in the form of a three-pin plug. The second socket is for connection to a TV receiver tuned to Channel 35, for displaying the contents of the MENTA memory. I used a Ferguson 3845 portable which gave excellent displays — certainly the best I have obtained from a modulated system. The third socket is for connection to a cassette recorder, the same socket is used both for output and input. All that needs to be added to the basic MENTA unit in order to start assembly-language programming is the TV reciever and, if you want to save and load programs, a cassette recorder.

Switch-on, Start-up

There is no mains switch on MENTA, the unit is simply connected up and the transformer unit plugged in to a 13 A household socket. When the unit is switched on initially, the first 256 bytes of its total of 1K of RAM are selected for display. This is described as page zero and a 0 is shown on the seven-segment display next to the keyboard as a reminder. As you would expect, when the unit is first switched on for a programming session, the memory contents of RAM will be 'garbage' and this can be removed by pressing the CLEAR key ***twice***. The need to press twice is a safety feature to avoid the loss of program which would result from pressing this key by mistake — typical of the careful thought which has gone into the design of MENTA.



Internally the MENTA is neatly laid out with all major ICs being socketed. The collection of tracks leading to the top of the PC provide I/O facilities.

The same press-twice protection method has been used for the RUN instruction so that you get a chance to record your program before you risk all by running it. The addresses of RAM start at F000 Hex in page 0, F100 Hex in page 1, and so on to F300 Hex in page 3, so that any absolute addresses which are used for testing programs should be within this range — other addresses can, of course, be substituted after a program has been tested.

When switched on, MENTA is in the direct mode and the symbols printed on the keypads themselves are the applicable ones. These can be used either for direct entry of Hex code or for commands. When direct entry is used, the unit expects two characters to be entered at each address so that 0F must be used rather than F, 02 rather than 2, and so on. The current memory location being used is indicated by a flashing cursor, whose position on the screen (and hence the memory being used) can be changed by using the UP, DOWN, LEFT and RIGHT keys. The memory address at which the cursor is placed may be temporarily stored by pressing the STORE key and this position returned to later by pressing RECALL. The initial, HOME, position of the cursor is always at the top left-hand corner of the page that is selected for display. The cursor will return to this position when the HOME key is pressed. Contents of memory on other pages can be displayed by pressing the PAGE key followed by the page number (0 to 3) and the page number will then be displayed on the seven-segment display while the memory contents of that page are displayed on the TV screen.

Now Try Your IQ!

Hex code can be entered just by typing in the code — the cursor will shift from one memory location to the next whenever two characters have been entered so that no incrementing key is needed — there's none of the fuss and bother over selecting ADdress or DAta keys, or incrementing the address that you have with the old-fashioned assessment units. A mistake can be corrected by left-shifting the cursor and re-typing. The program should be terminated by typing FF which is used by MENTA as a return-to-monitor instruction.

Compared to other assessment units, entering Hex code into MENTA is very fast and easy. It is also very easy to review the code because for educational work, the whole program will often fit easily into one page and can be seen at a glance. There is no reason why several programs should not be entered at different parts of memory and run completely separately. The cassette system always records the contents of the whole of the memory so that all the programs which are stored can be saved in one operation.

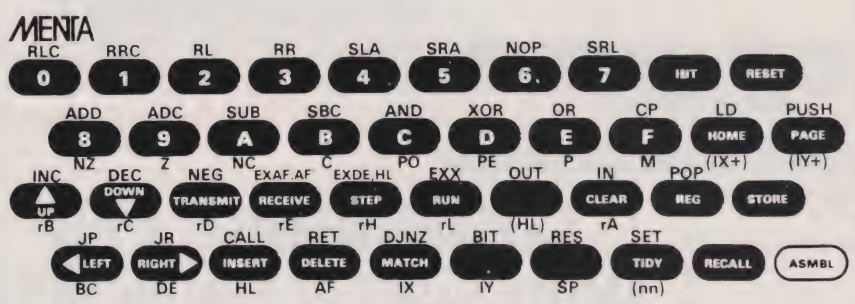
You obtain the full benefit of MENTA, however, when assembly

language is used. The ASMBL key, bottom right on the keyboard, is pressed to start entry in this mode and when this key has been pressed, the seven-segment display is used as a reminder of what function other keys will perform. Immediately after the ASMBL key has been pressed, the top bar of the LED is lit. This is a reminder that the next keystroke will carry out the coding of the assembler command which is printed in blue above the key which you press. This might, for example, be the LD command above the HOME key. Once a command has been entered, the LED will indicate whether the next entry is to be another command (top bar lit) or if further keystrokes are needed to complete the entry. In the example, when LD has been pressed, the next keystroke might be rA (register A), which is below the CLEAR key (printed in red) and the position of this will be indicated by the bottom bar of the LED display being lit. This makes the complete command LD A and it must be followed by the source of data, an address or another register letter. The bottom bar of the display remains lit until this data has been entered. The MENTA keyboard allows loading from any of the eight-bit registers or from (HL), (IX+n), (IY+n), or from a two-byte absolute address (nn). Only when an instruction has been completed by keying in its data will the LED display light its top bar to show that the next entry must be another instruction. The coding does not appear on the screens until the instruction is complete and the command byte, the Z80 code for the instruction, is highlighted. At the end of entering an assembly language program, pressing the ASMBL key will return the unit to normal operation. This can also be done during entry if needed and the unit will return to assembler entry when the ASMBL key is pressed again. Entering FF directly will then terminate the program as before.

Changing It Around

MENTA has excellent editing facilities. As a program is written, the first byte of each instruction is highlighted, as mentioned above, so that the code can be easily recognised. In this way, if an instruction has to be modified or deleted, the cursor can be moved to the correct position and new code entered. For deletion of code, the easiest method is to substitute 00 for each byte of unwanted code. This is the NOP instruction of the Z80 and will ensure that no action is carried out. If new code has to be added into the middle of an existing program, MENTA has the capability — unique among assessment units — of shifting code in memory to make room for new code. The INSERT function is not a cure-all — the cursor is shifted to the position for which an insert is needed and the INSERT key is pressed as many times as there are bytes to be inserted. If you are not sure how many are needed, the simplest scheme is to overestimate and pad with NOP instructions. Note that INSERT is a direct command so that you have to come out of assembly mode to use it. In addition, if new code is inserted between the ends of a jump, the jump displacement or its absolute destination address will have to be recalculated.

This is not such a hassle as it is on other units because jump displacements or addresses do not have to be worked out laboriously by hand — this alone makes MENTA highly desirable by comparison to older equipment. When a jump address is needed, the ASMBL key is pressed to leave assembly mode and the cursor is moved to the first (highlighted) byte of the target address. This address is then stored by pressing STORE. The cursor is then returned to the jump instruction and ASMBL pressed again to return to assembler mode. The jump instruction is entered but the RECALL key is pressed instead of entering a displacement byte or two number bytes. If the instruction was a jump-relative and the jump is legal (within the permitted range), then a displacement byte will be calculated and entered. If the jump instruction was a jump absolute, then the destination address (two bytes) will be entered into memory following the instruction code.



The keyboard is of the 'touch' type with most of the pads having dual functions accessed by the 'up' and 'down' keys.

The Verdict.

MENTA is a refreshing re-think of the methods used both to teach machine-code programming and to develop machine-code systems. You might think that there's less need for machine-code now that Parliamo BASIC is the order of the day, but you couldn't be more wrong. If we are to get anywhere in designing systems which use microprocessors (and that's what makes the money, not manufacturing the chips), we need lots of people who can program in machine code as easily as others can program in BASIC. In addition, we need people who can write better versions of high-level languages like BASIC and this is, once again, a job for the machine-code programmer. On this basis, MENTA should be welcomed by Schools and Technical Colleges because of its ease of use and low price. Also, systems engineers should welcome it as a Z80 assessment unit which is priced so low, even in one-off quantity, that it allows one unit per engineer. In addition, the port connections at the side of the unit allow interfacing to external circuits.

For the out-and-out amateur, (there are still a lot of us who like to be thought of that way) it fills a gap that used to belong to the Mk-14 (remember it?), but with immense advantages in terms of the use of the Z80 and the ability to program in assembly language. I think we shall see the main board of MENTA (quite small, incidentally) appearing in several robot designs, for example; it's an excellent method of learning Z80 code if your computer uses the 6502. For me, it's going to keep me in touch with writing Z80 code when I update my system from the old TRS-80 to the new BBC Microcomputer (make it soon, Acorn, make it soon).

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Featuring You

The main bulk of the magazine is usually taken up with feature articles, reviews, projects and general topics. Each of these articles attempts to convey the necessary information as clearly and concisely as possible, at the same time remaining easily readable. Articles of this nature can be thought of as similar to a school 'essay' in that they must have a beginning, a middle and an end. Diagrams and photographs are an enormous help to any article, the old adage of a picture being worth a thousand words holds very true in this case.

If you are a regular reader of the magazine you will know the 'style' in which we write. Generally each section of the article that deals with a new topic is given its own heading and, while not essential, headings do help to increase the readability of the final text. We prefer all copy to be typewritten on one side only of a page, using double line spacing and with large margins on each side of the text.

All associated diagrams and photographs should be clearly labelled both as to their intended use and as to where they relate in the text. Circuit diagrams should follow the standard style of component designation and layout that is used throughout Computing Today. All components used in a given circuit must also be listed in a single table or Parts List to avoid any possibility of confusion.

Programming For All

In general the format for computer programs follows that of articles. We ***cannot*** accept any program that is not accompanied by a full listing, and TAPES ARE TOTALLY UNACCEPTABLE. While it is desirable to have a printed listing, it is not at all reasonable to expect everyone to have access to a printer so typewritten copy will be considered.

Remember to include sufficient detail to enable people who don't own an identical piece of hardware to be able to follow your program. You must also include descriptions of any part of the software that is unique to your machine; SYS calls, POKEs etc. All graphics characters must be detailed with their associated codes and cursor controls should be presented in the CT standard format. The use of printers which give graphical output is acceptable provided all the graphics are fully expanded. It is often worth including a photograph or drawing of the display produced or an actual sample run if possible.

Remember that the frustration you feel when you can't run a program, due to lack of documentation, will be felt by everyone else if YOU send in a program in that same state!

Soft Spots?

The Softspot features are really programming ideas that are submitted by readers. Because of this they do tend to be for specific systems. They must be submitted in the same format as other programs, ie printed or typewritten, but will probably contain less general detail and more specific machine instruction.

Paying For It

It takes up to four working weeks for any submitted material to get through the system. At the end of this period a decision is made as to whether it is acceptable or not and, if it is, a letter will be sent informing you of its acceptance and the rate offered. If it is found unsuitable we will return the program or article at this stage.

All payments are made upon publication, that is you will receive your cheque in the same month as the magazine appears on the streets.

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Benefit To All

Writing for a magazine like CT not only gives you the pleasure of knowing that some 75,000 people read what you have written, but also goes some way to paying for that new piece of equipment you have set your sights on.

DEAR DESIGNER OF OUR FUTURE,

Computer programmers are already ten-a-penny. The future is for ENGINEERS who can design microprocessor based products. What is stopping YOU designing with micros? If you can claim better than average intelligence and determination the answer should be — nothing! Times have never been better for the man who likes to tinker and find things out for himself. This is based on personal experience. I have designed a dozen micro-based products which are still selling — and I have no higher education or electronics background (I was nearly forty when I learned Ohm's Law).

UNDERSTANDING THE LANGUAGE.

Microtechnology seems a black art to the newcomer, mostly because of the terminology. But nine times out of ten the concepts which go with the unknown terms are already familiar to you or self-evident truths. It's a fact that each step of system design and programming is essentially simple because the micro itself is simple. The micro is a painstaking device which relies on perfect short-term memory and speed to perform complex tasks in easy steps.

GETTING STARTED

There is no secret to starting. What I did was to buy microprocessor and memory chips and find out how to wire them up (No problem. All the pins are labelled: there is only one way to do it). However I do not recommend you to start from scratch because you will come up against the same problem that I did: how do you put the program into memory in a way that lets you see it and edit it? And how do you store it and make it permanent?

AVOIDING WASTED TIME.

This caused me a long detour but I can save YOU the trip because I came back with a solution. At the time I was working there was no cheap development system on the market. The first to appear was the Sinclair MK14, a useful device which got a lot of people started. Development systems have a keyboard and display — and a program in ROM which allows you to enter and edit code. But the trouble with buying a ready made kit is that you are committed to the circuit and the processor. Your imagination is restricted. You are treading the same path as everyone else. I designed SOFTY to solve these problems when building my Chess Player's Visual Recorder (TOLINKA).

A UNIVERSAL DEVELOPMENT SYSTEM.

The funny thing is that I never intended SOFTY to be a commercial product! I built SOFTY because I needed one. I did not realize then that the development tool was the more important product: SOFTY has gained acceptance in industry and education all levels. Our customer list reads like a Who's Who in Electronics. There is even a SOFTY on display in the Science Museum.

TV DISPLAY

SOFTY uses your TV set to display the contents of data memory. This is like having a window into the working memory of the micro. SOFTY has this unique method of converting memory directly into visible hexadecimal code. SOFTY is ROM-emulator (or ROMULATOR) which just plugs into the system you're developing where the EPROM goes. You can shift code around without overwriting, do insertions, deletions and hex arithmetic to calculate relative jumps. There are parallel and serial inputs to link up a computer and similar outputs to print the data on a standard printer. SOFTY converts Hex to ASCII and has routines for 110, 300, 600, 1200 and 2400 baud-rates. The CASSETTE RECORDER interface permits code to be stored on tape. SOFTY is an EPROM programmer too. SOFTY1 is an open-board device which programs 3-rail 2708 and 2716 EPROMS. SOFTY2 has a sleek black case and it kprograms single-rail 2716, 2732 and 2532 EPROMS. For small system development and manufacture SOFTY is the only tool you will need.

Customers often tell me that SOFTY is the most useful tool in the lab — and that SOFTY is underpriced. That must be true because companies are now selling remarkably similar equipment for three times the price. Before buying a copy which is oversized and overpriced do look at a real SOFTY first.

LEARNING MICRO TECHNIQUES

Teachers appointed by the Schools Council to teach microprocessor control as a project (Modular Courses in Technology) looked at all the available hardware. The only thing they liked was SOFTY. The personal computers were out because they gave no INSIGHT. I was invited to a meeting and a specification was written for the ideal device: a product like SOFTY intended to provide insight into the workings of the micro and for experiments in control. I was given an order for a quantity of Micro Electronic mNemonic Teaching Aids — called MENTA now.

MENTA — AN IDEAL MICRO TUTOR?

MENTA uses the power of the Z80 type microprocessor to make a TV picture mainly by software. MENTA has the advantage of permitting program entry in both HEX and ASSEMBLY LANGUAGE with STEP-BY-STEP EXECUTION which lets you see your program in action. BREAKPOINTS can be inserted and deleted by a single keystroke. The contents of the REGISTERS and the STACK can be seen. There is a CASSETTE RECORDER interface too. MENTA could be called a super-sophisticated development system. There is no other piece of equipment on the market which gives the same INSIGHT that MENTA does.

Menta comes with a fair-sized manual which includes suggestions for use of the 24 availabel input/output lines to control MACHINERY, ROBOTS etc. Learning with MENTA is not at all boring because you can quickly progress to controlling things. Some fun-and-games like BATTLESHIPS and MUSIC BOX programs are included (which have a serious tuitional purpose I hasten to add). COURSE MATERIAL and plug-in control boards will be available through the SCHOOLS COUNCIL in BROMLEY, Kent.

MICRODOCTOR — A DIAGNOSTIC AID.

DATAMAN will have another new product soon. MICRODOCTOR is a diagnostic tool for sick microsystems. I see a need for a tester which will look around in addressing space and report what it finds there, check the ROM and RAM, work the peripherals etc.
MICRODOCTOR will save lots of time spent troubleshooting bad systems both on the production line and in the repair shop. The output device is a small PRINTER. You program MICRODOCTOR with a test made of these instructions: CHECKSUM, RAMTEST, HEX DUMP, ASCII DUMP, DISASSEMBLE, WRITE, READ, INPUT, OUTPUT, DELAY. All the instructions have parameters like where to start and where to finish. Each test can have up to eight instructions and you can have up to fifteen tests. Battery backup retains the programs when the power is off. For many purposes MICRODOCTOR is better than a Logic Analyser because it gives an instant printed report and it can be used by a non-technical operator. A FREE Z80 DISASSEMBLER will be included: disassemblers for other micros will be available at around £35 extra cost. The price will be around £300 but I can't give you a delivery date

OLIVETTI TYPEWRITER INTERFACES

We make interfaces for Olivettis of the ET121 and ET221 kinds, which permit the machines to be used as printers from standard busses (RS232, IEEE-48, Centronics Parallel). Use of the typewriter with any computer is possible. These interfaces are offered only to dealers who can fit them.

PRICE LIST

PRODUCT	PRICE EX. VAT
SOFTY1	£120
SOFTY1 PSU	£20
SOFTY2	£169
MENTA	£115
ET121I	CALL
ET221I	CALL
MICRODOCTOR	CALL

Quantity prices are available. Dealer and export enquiries are invited.

MONEY BACK GUARANTEE.

Don't worry about being disappointed with the goods. You can have your money back promptly if you return the product within 30 days. I am quite happy for you to order the goods for approval in this way rather than ask for literature. I know you don't want to wait — most orders go out Securicor or First-Class Post the same day we get them. My home address and phone number appears on all invoices.

ALL PRODUCTS ARE EX-STOCK at time of writing (except **MICRODOCTOR**). Jim Bennett, who manages the business, is available on Dorchester 68066 (STD code is 0305) to answer enquiries.

Yours sincerely, (Barry Savage).

DATAMAN DESIGNS, LOMBARD HOUSE, CORNWALL ROAD, DORCHESTER, DORSET.

YOU'LL LOVE IT . . .

If you own a PET or CBM computer with disks then you ought to have a COMMAND-O chip. It's got all the facilities of that other chip (can't think of the name), plus BEEP, EXECUTE, INITIALIZE, PRINT USING, AUTO-REPEAT — and you can scroll a program listing up and down the screen! There are lots more functions, but perhaps the best way to learn about COMMAND-O is to use one. If you order a COMMAND-O chip from SUPERSOFT before 31st March you'll qualify for our special monye back offer. Just return it in good condition within 10 days and we'll refund your money in full! COMMAND-O is for Basic 4 users only and costs £59.95 plus VAT. It fits in the UD3 or UD12 socket and comes with a comprehensive, but readable manual.

OR GET YOUR MONEY BACK!

ARROW is a chip that will be of particular interest for committed tape users — because it will LOAD, SAVE and VERIFY at 7 to 8 times normal speed! There are lots more features for just £30 plus VAT, but since we're making the same money back offer why not try it out. Don't forget to tell us which machine you own (it works on all models except the original Old Roms) and which socket is available.

FREE 1982 CATALOGUE

Our 1982 catalogue is now available, and it's absolutely free to PET owners (don't forget to tell us which machine you've got for our computerised mailing list!)

New programs in the catalogue include SIMPLIACALC (£26 on tape, £32 on disk), INSTRING (£10) which searches for one string within another, and LINK & SHRINK (also £10), a fascinating program that saves space by joining Basic lines togehter.

And of couse there are new games: LOST VALLEY (£14) is a successor to the very popular HALLS OF DEATH, and CRACKS OF DOOM (£16) is a new tape-based aventure from the author of our HITCH—HIKERS GUIDE TO THE GALAXY game. These two both need 32k of memory, but GOMOKU (£8) will run in 16k.

80 — COLUMN GRAPHICS

Yes, at long last the HR-80 HIGH RESOLUTION GRAPHICS BOARD is available. And we've managed to hold the price at just £149 plus VAT! The resolution is 320 by 200, the same as on our HR-40 board, and of course the bord has 8k of its own RAM plus GRAPHIX utility software in a chip. Write or telephone for an information sheet or for furthr details about any SUPERSOFT products.

ADD 15% VAT TO PRICES — POST & PACKING IS FREE

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Henry Budgett

If you are new to the world of personal computers it's probable that you are more than a little confused by all the jargon. We proudly present the plain man's guide to 'technospeak'.

When we first brought out our Buyer's Guides, the decision was taken to present all the relevant information in the simplest form possible. We broke the various computers down into their essential components and presented a comparative list. The Guides were not a roaring success!

The reason for their initial failure is now obvious, we didn't explain the meaning of the words we were using, RAM, CPU, I/O, etc and the very people for whom the Guides were intended — the first time buyers — found them very hard to take in. As soon as we had recognized this failing we published explanations to each of the Guides; the result was that they became much more widely used.

Looking at the problems we created for ourselves with those early Guides, it has become very obvious that there is a need for a simple, plain-English explanation of all the technical jargon in use. The last time we published one was back in May 1980 where we featured 100 of the most common pieces of jargon. This new feature is a complete update and will be repeated every few months for our new readers.

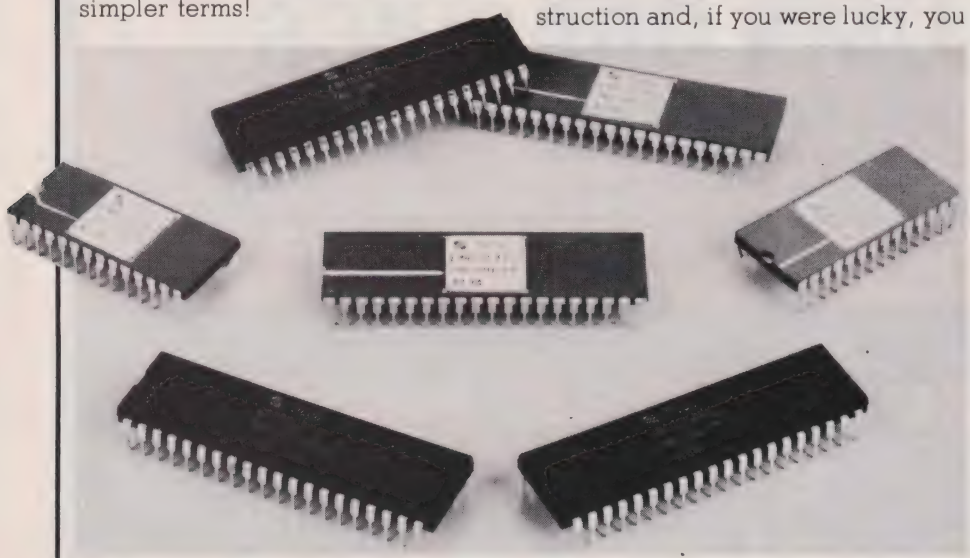
Computing Components

Every single computer can be divided up into a number of fundamental segments, this not only makes them easier to understand but also helps us write about them in simpler terms!

The heart of each computer is the **Central Processing Unit** or **CPU**. On large computers this is a vast collection of circuits filling at least an entire printed circuit board and often an entire box. In the world of the personal computer, however, this has all been reduced into the space of a single integrated circuit, the **microprocessor**. This device contains all the necessary logic to take information in, process it according to a set of instructions and pass it back to the outside world. The speed at which it performs these operations is governed by two factors; first, the way in which the device has been made and second, the speed of the **clock**. The clock is simply a very accurate oscillator which beats millions of times a second; typical speeds are between 1 and 4 million cycles a second or MHz to use the proper SI units.

The actual logic contained within a microprocessor varies according to the technology available at the time it was designed, but suffice to say that they are more complicated than I would wish to explain on these pages.

The simplest form of computer can be built from a set of switches, a microprocessor with its correct clock circuit, a power supply and a set of lights. If you set up the correct code on one set of switches, the device will take in the information presented as an **instruction**. You could now give it some more information — **data** — then another instruction and, if you were lucky, you would see a **result** displayed on the set of lights. Systems such as this are often used in schools and colleges as basic training aids for students learning about microprocessors; they are not often found in the real world.



The set of instructions we give the computer is called the **program** and as we have been programming in the simplest possible form, **binary**, we call this **machine code programming**. It is often possible for the user of a microcomputer to program the system in machine code but we very seldom use the binary notation — remembering all those 0s and 1s is not easy. What is generally allowed, however, is the use of a code system called **hexadecimal, Hex** for short. This can be used because virtually all of the common microprocessors use **eight bits** to make up each of the instructions they use (eight bits is called a **byte** and this is the fundamental unit of information as far as the user is concerned). The Hex system allows the eight digits required for the representation of binary to be reduced to two digits.

Elephant's Graveyard

It would obviously be very nice to store a set of instructions — the program — somewhere in the computer rather than having to key them in one at a time. The breed of device we use for storage is called **memory** and this can be one of two fundamental types. These are commonly called **Random Access Memory** and **Read Only Memory**, that's **RAM** and **ROM** in the jargon, but these names do not really describe the true workings of their systems.

Random Access Memory comes in two types, **static**, which uses rather a lot of power but is very fast, and **dynamic** which uses less power but pays for this by being somewhat slower. As far as the user is concerned they are identical — only the electronics engineer would want to dig further. Memory areas which are made up of RAM can be written to and read from; information can be stored and retrieved at the programmers wish. However, if you turn off the power the contents are lost, fine for temporary information but not so good for programs and data.

TERMINOLOGY TRANSLATED

A typical modern VDU with its full function keyboard.

The second type of memory, ROM, comes in many guises but once the information has been stored it is there for good, the user can read it out when required but it cannot be destroyed by turning the power off. This sort of memory is used for all the programs which come built into the computer; these are the programs you often don't realise are there, such as the program to take a character from the keyboard and the one which displays that character on the screen. All these hidden programs come under the general heading of the **Operating System** or **Monitor**.

All the information stored in memory is held in blocks of eight bits, the byte we mentioned earlier — each byte corresponds to one single character. Most common computers use a coding system for the numbers and alphabet, and other special symbols called **ASCII** code which stands for the **American Standard Code for Information Interchange**.

Using the binary system where each of the eight bits (a bit is a binary digit just as 8 is a decimal digit) can be either 1 or 0, we can have a possible 2^8 combinations or patterns and as the full ASCII set only uses 128 of these, the manufacturers of microcomputers often add extra characters such as special graphics symbols.

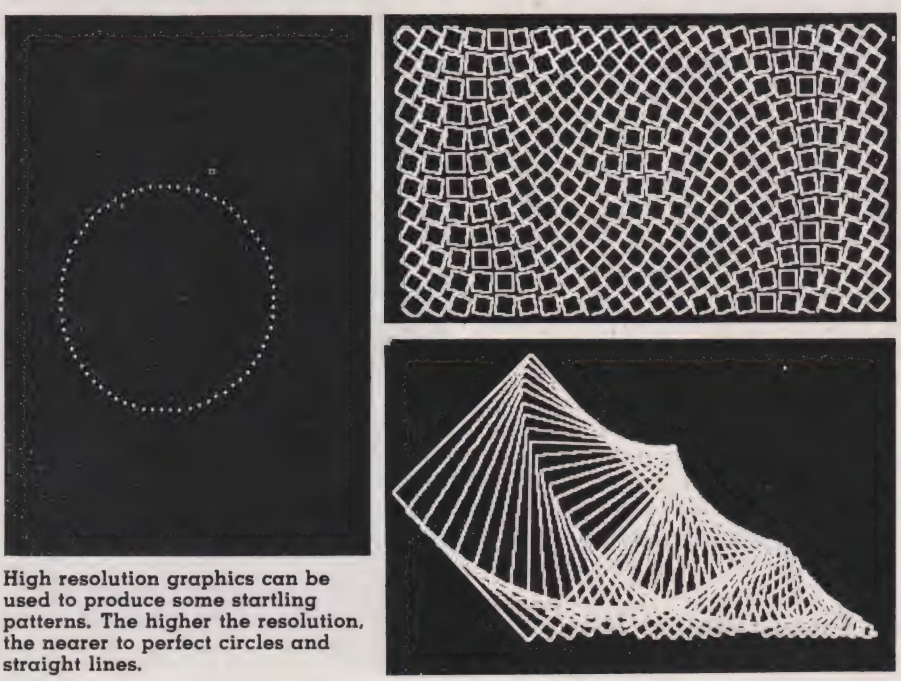
The amount of memory a given microprocessor can use is limited by the number of **address** lines. A normal eight-bit micro generally has 16 address lines and, using the same formula as the ASCII code, we can connect up to 2^{16} or 65,536 bytes of memory. This number is generally referred to as **64K** where the **K** signifies binary thousand or 1024. It is possible to connect more memory to a microprocessor using special techniques but only 64K of this total can be used at any one time.

Peripheral Proliferation

So far we have covered the central processor and the memory but we still can't actually use the computer because we have no way of getting information in or out. Devices such as keyboards and TV sets are the most common and these, together with their more exotic cousins, are all called **peripherals**.

As far as the typical personal computer is concerned, a **keyboard**, which looks somewhat like the one you would find on a typewriter but generally with more keys, is used for communication. The computer's processed information, the program you are working on or anything else, is displayed on a **video screen**. This may be your domestic TV or a special video monitor or, in high-class systems, the screen and keyboard may be combined into a single unit called a **Visual Display Unit** or **VDU**. Some complete systems are built into what looks like a large VDU and these are often called **desktop** computers.

The type of display you get on a TV or video screen varies from system to system but is typically expressed as so many **lines** of so many **characters**, 25 by 40 and 16 by 32 are typical. As well as the supplied graphics characters I mentioned earlier, some systems allow the user to produce true graphics; plot points, draw lines and so on. The capabilities of these systems are generally expressed as the number of **dots** that can be displayed across and down the screen. The larger the number, the higher the **resolution**



High resolution graphics can be used to produce some startling patterns. The higher the resolution, the nearer to perfect circles and straight lines.

you will be able to obtain. In practical terms this can be demonstrated by getting the system to draw a circle; the higher the resolution the nearer the result will be to a 'perfect' circle.

The keyboard and display are the two most vital components of the system, without them you can't use the computer. However, the computer is capable of being connected to much more exotic devices and the capacity for these connections is referred to as the **Input/Output** or **I/O**. Once again there are many different kinds of I/O connections, generally known as **interfaces** because they form the junction between two separate items. We can break these down into two groups, **serial** and **parallel**. The most common name associated with the former is the **RS232** standard which is used for many of the common peripheral devices such as printers, VDUs and even for connecting between two different computers.

The parallel interface is so called because it allows one entire byte to be transferred at a time, the serial interface transfers each byte bit by bit (that's not a pun either!). Two special sorts of parallel interface are frequently found, the **Centronics** printer interface and the **IEEE-488** communications interface.

In order to control the way in which information is passed over these interfaces, special control signals are used and these come under the delightful heading of **handshake** lines. The name describes their action exactly.

There is one further type of I/O which is fundamental to the computer and that is the **bus**. This is the collection of interconnections which allows various parts of the computer to share sections of the processor. In many computers they are limited to the main processor board and the memory, but in more recent designs they are often gathered together in some logical order and brought out of the computer so the user may add extra facilities to his basic system. Names such as S-100, S-50, Eurobus, Multibus and a host of others can be found in the literature. In theory, if your computer has a defined bus structure then you can plug in any other extra, such as more memory, built to the same structure and it will work.

Needless to say, the world is far from ideal . . .

Programming The Beast

Earlier in this piece I mentioned that writing programs in machine code (binary) or even their Hex alternatives was somewhat irksome. Well on many systems, some basic, some complex, you can have a special program fitted into the computer called an **Assembler**. This allows you to write your programs in **assembly code**, that funny mix of letters and numbers where you often see things like LDA, JMP and RET. These are called **mnemonics** and are translated by the assembler program into machine code which the computer can then run.

Programming the computer by these methods is laborious in the extreme and is generally avoided by providing the user with something called a **high-level language**. The most common of these, at least as far as microcomputers go, is **BASIC**, which is the acronym for **Beginners All-purpose Symbolic Instruction Code**. You'll see a lot of it in its various forms between the covers of this magazine and it is relatively easy to learn and use. The main advantage that it has for the personal computer user is that it is an **interpreted** language; this means that you can easily change things around if they don't work or even improve those that do.

An **interpreter** is another program built into the computer which allows you to type in such apparent nonsense as FOR K=1 TO DL: NEXT. The interpreter quite happily accepts all this, stores it away and when commanded to RUN, the program sets about converting it all into machine code so that the central processor can actually do something with it. All this translation takes time and programs written in this sort of language run considerably slower than their machine code equivalents, so some computer manufacturers offer a special program called a **compiler**. This allows you to develop your program and thoroughly test it using the interpreter and then convert it completely into machine code. You now store away the old program and just use the much faster machine code version.

A 5¼" floppy disc with its protective envelope cut away.

There are many programming languages; BASIC, Pascal, FORTH, COMAL, ALGOL, FORTRAN, etc, etc and they all have something to offer the user for his or her specialised use. Much argument has raged over good and bad programming techniques and which languages should be used for what but, in general, BASIC can still be regarded as the easiest to use and quickest to achieve results from.

Keeping A Copy

All this talk of writing programs and a glimpse of the pages of BASIC and machine code in this magazine may have awakened a memory of something I mentioned earlier — RAM forgets when you turn the power off. What you really need is some way to store a copy of your program so that you can re-use it at a later date. Storage of this type is called **backing** or **off-line** storage and is generally based on **magnetic** recording techniques. The simplest and cheapest method is the **cassette tape**. In many cases you don't even need a special cassette recorder although digital-quality tape is to be recommended. The system works by converting each bit into one of two **tones**, a high tone if its a 1 and a low tone if its a 0. These are then fed, serially, on to the tape at a given speed. This speed is generally referred to as the **baud rate** but a more accurate definition would be the **bits per second** or **bps**. Obviously, the faster the transfer rate, the less time it takes to save or load your programs, but (relatively) the faster you save, the less reliable the process becomes.

The cassette comes in for much criticism for its slowness but it is unlikely to be superceded at the price for many years to come. The next step up the ladder is still tape-based and is called the **floppy tape** or **stringy floppy**. This is a much smaller and faster continuous loop rather like a miniature eight-track cartridge (remember those?). The real gain for the user is that the unit comes with its own Operating System which makes it much easier to use.

Another step up the storage ladder is the **floppy disc**. This comes in two sizes; **5¼"** and **8"** and is rather like one of those flexible gramophone records but made out

of the same material as recording tape. This is enclosed in a cardboard envelope and spins round inside a **disc drive**. The information is stored in the disc in concentric rings called **tracks** each of which is broken up into a number of **sectors**. A basic single sided, single density 5¼" floppy disc holds about 200K of information; if you want more room you can go to double density or even quad density, but the remarks I made about fast storage on tape apply here too. Much better, if you can afford it, to use 8" drives and discs, these are the ones the professional systems use.

The Rolls Royce of storage media is the **Winchester disc**. These come in sealed boxes and replace one of your 5¼" or 8" drives. Because the discs inside are rigid, the tolerances to which the unit can operate are much higher and they can often store some 10M (megabytes) of information per 5¼" unit. The price of the unit, currently, is around £2,000.

All of these discs have a sophisticated piece of software supplied called a **Disc Operating System** or **DOS**. Typical examples here include CP/M, FLEX and UNIX. These allow the programmer or user to issue a single command such as INITIALISE and the DOS will then perform a complete set of operations to prepare a new disc for use.

Using The System

All this stored information is very nice but only being able to read it on a TV screen is a little limiting, words on paper can be more use at times. The printed copy of something held on a computer is known as **hard copy** and you need a printer to get it. Printing devices can be broken down into two fundamental types and two methods of printing. The two types are **impact** and **non-impact**; this simply refers to whether the character is formed by banging something through a ribbon or whether it is created by thermal or electrostatic processes.

The methods most commonly found are **character printing**, this is where a complete character is formed on the paper at one go — just like on a typewriter — and **matrix printing**, where each character is made up from a number of dots.

The best quality print comes from an impact character printer and examples of these are the **daisywheel** and **golfball**. The daisy has the letters arranged around the rim of a slotted disc as compared to it's close cousin the spinwriter, which uses a cup-like carrier for the letters.

Although the quality of text produced by a matrix printer is not quite as good as that produced by a character printer, it has the considerable advantage of being cheaper and more flexible to use. If you have a system which can produce special graphics characters then unless you want to spend a fortune on having special daisywheels or golfballs made, you need a matrix printer. Each needle of the matrix in the printing head can generally be controlled separately. This allows you to either have your own character set installed in a ROM inside the machine instead of, or in addition to, the one supplied or even to control the needles as you are printing and so produce actual copies of the dots on the screen.

Over the last ten years, since matrix printers were invented, they have undergone a remarkable transformation. They are now cheaper to buy and fitted with more facilities than at any time in the past. A typically priced unit — around £400 — will offer choice of character sets, produce graphics and more — it may not be as robust as a daisywheel or golfball printer but it is unlikely to be forced to produce reams of copy every day anyway.

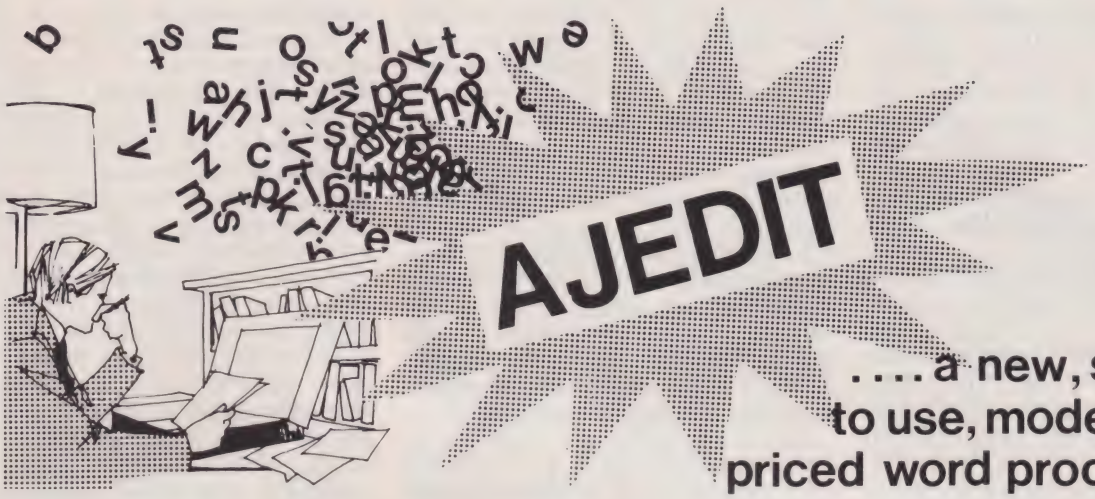
In Passing

This has been no more than a brief illustrated trip through the world of 'computerese'. If you have read this far and feel you now have less questions to ask than you did when you started, then it has served it's purpose. If, however, you have more questions than you started out with, drop us a line at the magazine and we'll make sure that the next time we print this that those items which confused you are better or more fully explained.

Ideally you should now be in a position to read and understand the basic principles behind most of the articles in this magazine and thus gain even more knowledge about the subject. It should also help you to decipher all those specifications the advertisers put before you each month; you know the sort you're sure they are what you want but you wish you could understand them!

A high speed matrix printer being used to reproduce high resolution graphics images.

INNOVATIVE
TRS 80-GENIE SOFTWARE
from the professionals



The introduction of a brand new word processor is a major event and AJEDIT is without doubt a major program. There are, however, quite a few Word Processors around and most of them are extremely good ones - why, therefore, another? The question is even more pertinent when it is known that we specifically commissioned the writing of it from an author of the status of Denville Longhurst of Enhanced Basic fame. The answer is that user feedback shows that a large number of customers do not need or want word processor programs which require a quantity of training before use. Scripsit, for instance, is an excellent program, but is complex to use; it even comes with a training course on tape. If one operator is dedicated to using the word processor then it makes sense to have her trained, and the more complex the program (so long as the complexity is accompanied by more and bigger functions) the better.

AJEDIT has been written for the user who needs a word processor intermittently, say three or four times a week. Its prime design criteria was ease of use - and just as importantly - ease of recollection of its commands. Take, for instance, the text editing commands - they are as close to the Basic Edit commands as possible, so that the user will remember them: To insert type I, to delete D, to take out three letters type 3D and so on.

Furthermore, AJEDIT has benefited from being written after a number of other word processors. The deficiencies in its predecessors are corrected in AJEDIT. For instance, any control characters can be outputted so that full advantage can be taken of the features of the particular printer being used. Disk directory access is available from within AJEDIT as is the killing of files on the disk. The FREE command and a number of other DOS commands can be carried out from within the program with a return to AJEDIT - with its text intact.

AJEDIT contains close to one hundred commands covering most word processor requirements. Dedicated printer commands for the Epson MX series and the Centronics 737 are included - again for ease of use of these two popular printers.

One of the big features of AJEDIT is the ability to "mail-merge". The facility is available whereby two special files are created, one containing names and addresses and a salutation, the other a standard letter or form. AJEDIT will call the address and salutation from one file and the letter from the other and thereby compile personalised letters. The salutation may be repeated in the body of the letter.

AJEDIT needs 48K and one disk minimum and is suitable for the TRS-80 Models I and III and the Video Genie Models I and II.

AJEDIT **£49.95**
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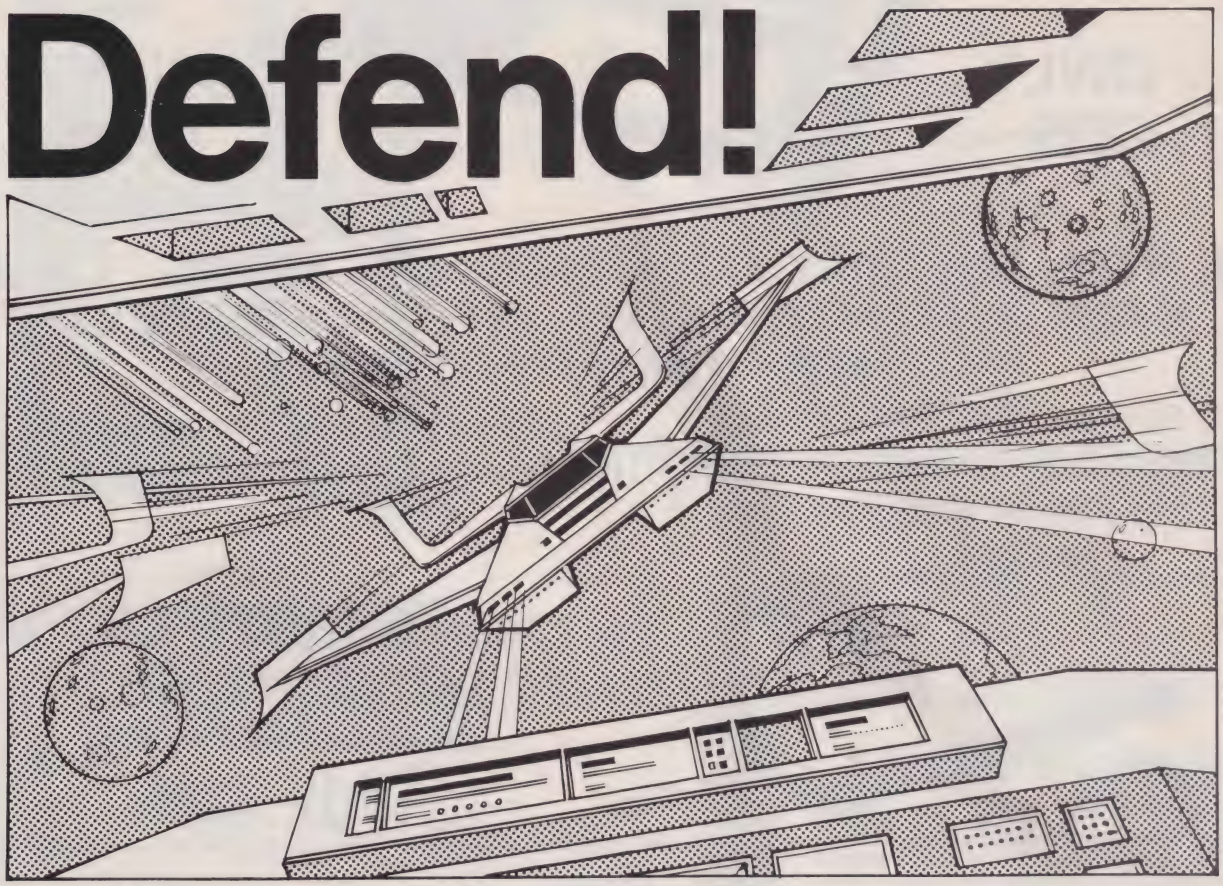

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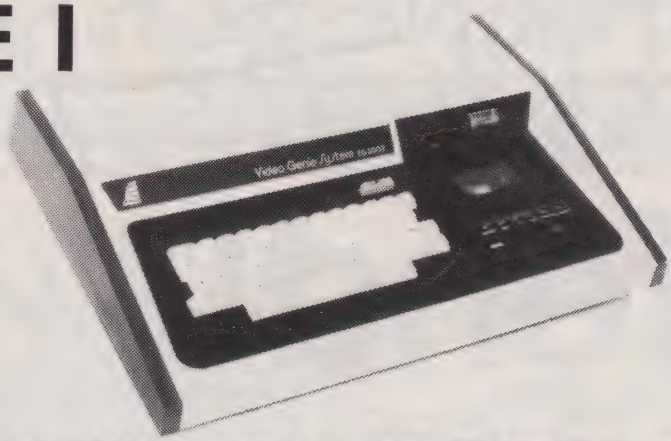

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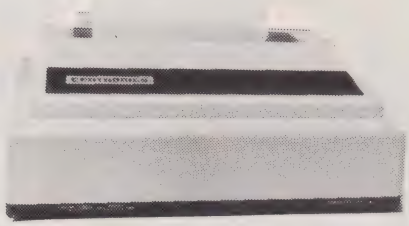

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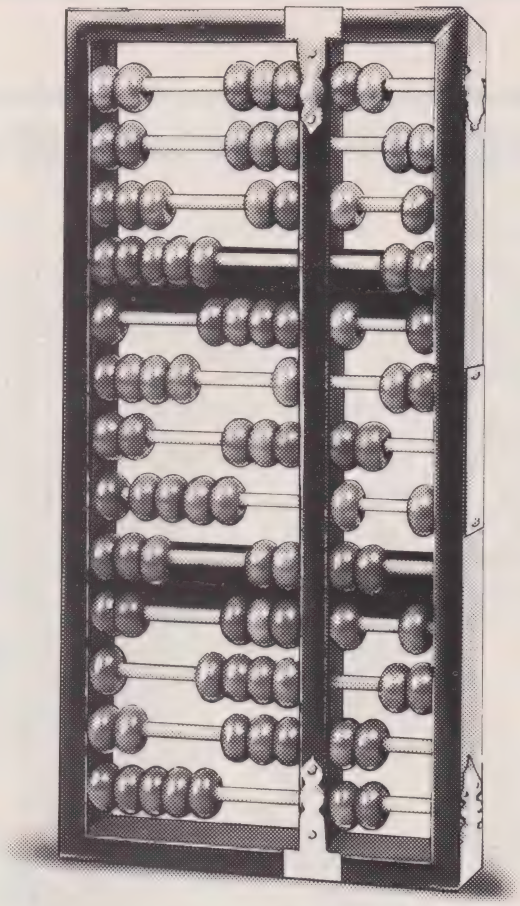

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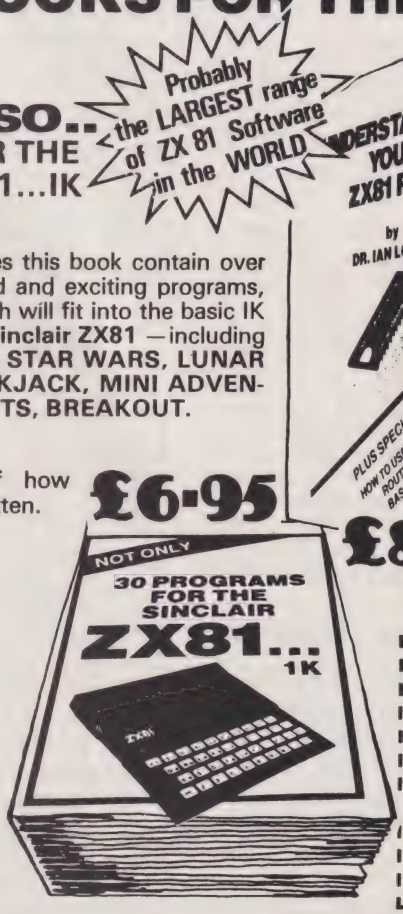

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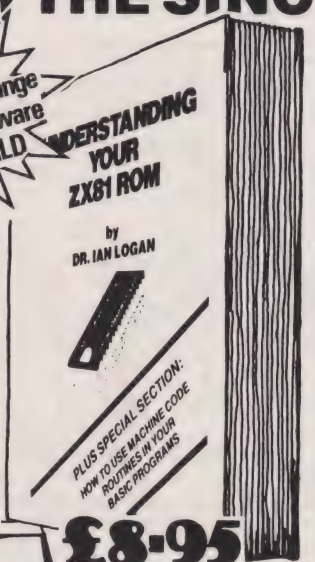

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Yet more vital details about this language in our continuing series for the programmer

So far in this series, we have seen enough of FORTH to realize that it is more than a little unusual. I hope, however, that it is becoming clear that the language has considerable advantages in many circumstances and that it might well be worth getting used to its back-to-front way of doing things.

Last month, I explained how it was possible to extend the language to include almost any facility you might want. We went on from there to look at FORTH's basic conditional operators and the way that branching and looping structures are set up. This month, we will look at conditional loops in FORTH and the significance and use of the language's two stacks. I will also outline the language's assembler mode and introduce some new words.

Before we start, however, let me remind you that where necessary, FORTH words are enclosed in square brackets — **[ ]** — to make them stand out clearly. (**Those familiar with FORTH may have been having a quiet chuckle at our use of quotes to indicate reserved words, the quote symbol itself being a reserved word! We are now substituting square brackets, and anything enclosed by these should be taken as being FORTH and not text. Ed.**) In addition, wherever I show a dialogue with the computer, the computer's responses and prompts are underlined.

Conditional Loops In FORTH

Last month we saw how to construct conditional branches (BASIC's IF...THEN...ELSE) and finite loops (FOR...NEXT in BASIC). While you can do an awful lot of programming with just these two structures, they are sometimes very limited and force you into rather involved bits of code. In particular, you may wish to loop an unknown number of times until an event takes place, or you may wish to loop while a set of circumstances are true (or false).

While these two conditional loops are very similar, they have the fundamental difference that, in the first case, the program will always go through the loop at least once while in the second case it is possible to omit the loop operations altogether. Examples of these types of loop are found in Pascal's REPEAT...UNTIL and WHILE... DO.

You will probably have guessed that FORTH also provides these structures. An example of the first type, in which a function must be repeated until a condition occurs, is the processing of a string of input items. BASIC has to resort to conditional GOTOs to handle this case, but FORTH provides:

```
BEGIN <operation> <condition> END
```

If the <condition> gives FALSE (ie, TOS=0), the loop goes back to BEGIN. If, on the other hand, the test is TRUE, then the program picks up at the operation after END. Figure 1 is a flowchart for this function. Note that both <operation> and <condition> can be any suitable combination of words, including other loops, etc.

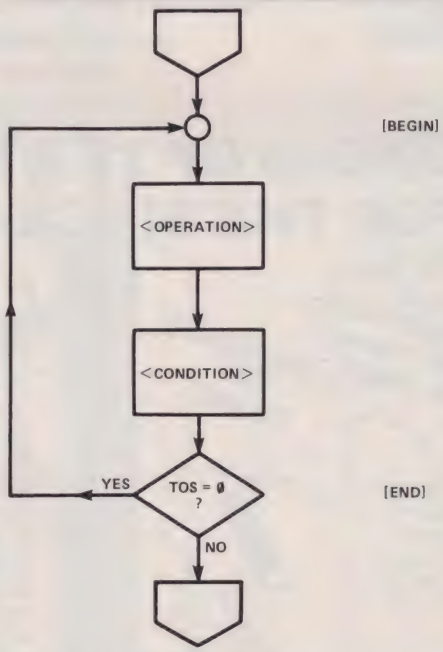

Fig. 1. The BEGIN...END construct in FORTH

As an example, let's define HEXPRINT to input decimal data from the keyboard and print its hexadecimal equivalent. The loop is to finish after inputting (and converting) decimal 100. The answer is:

```
: HEXPRINT BEGIN CR #IN DUP HEX .
  DECIMAL 100 = END ;
```

This example also introduces three new FORTH words. The first, **[#IN]**, is not actually a standard FORTH word, but is an MMSFORTH extension which prompts for, and accepts, a numerical input. HEX and DECIMAL demonstrate the language's ability to accept and print data in any number base. The system normally treats data as decimal, but type HEX and both incoming and output data are handled as hexadecimal. DECIMAL takes the system back to base 10. OCTAL, similarly, puts the system into a base 8 mode. In fact, virtually any number base can be used by putting a suitable value into the system variable BASE. Type:

```
23 BASE C! OK
```

and you are in base 23 (and the best of luck...). No matter what I/O base you choose, data is always stored in a two-byte signed binary format.

However, back to the example:

```
HEXPRINT
? 1     1
? 20    14
? 79    4F
? 100   64 OK
```

BEGIN...END is very useful, but has the weakness that <operation>is always performed at least once. Sometimes the first test can fail, meaning that there is no need for <operation> at all. MMSFORTH provides this option by:

```
WHILE <condition> PERFORM <operation>
PEND
```

This structure tests <condition>, and executes <operation> if the TOS is '1'. The PEND then loops back to WHILE to repeat the test again; Fig. 2 shows the operation of the function. Notice another difference between this and BEGIN... END; <operation> is PERFORMed if <condition> is TRUE, but END repeats <operation> if <condition> is FALSE. You have to watch your test ***very*** carefully.

Although MMSFORTH uses WHILE...PERFORM...PEND, other versions of the language use functionally identical constructions such as BEGIN...WHILE... REPEAT or BEGIN...IF...WHILE.

Repeating the HEXPRIN example above using this construction is easy:

```
: HEXPRINT  WHILE CR #IN DUP 100 <>
            PERFORM HEX . DECIMAL
            PEND DROP ;
```

This time we can have:

```
HEXPRINT
? 100   OK
```

without the conversions being performed.

'Why two versions of the indefinite loop?', you say. Most of the time, either would be perfectly acceptable but if data must be processed until an appropriate result emerges, use BEGIN...END. At other times, the input data controls the need for further processing — in such cases, the second construction is better. The second version of HEXPRINT is more suitable.

Just like the looping and branching structures we looked at last month, BEGIN, END, WHILE, PERFORM and PEND are ***Defining Words*** that can only be used within colon definitions. If you try to use them in FORTH's immediate mode, you will get an error message.

I hope that it goes without my saying that all these conditional and looping structures can be nested pretty well as much as you like. Next month's article, will contain a FORTH program called "HANOI" which gives examples.

Assembly Language

Since two of FORTH's major advantages are its running speed and the very free access it gives to the computer's operations, there is very little need to use assembly language segments in FORTH programs. Nevertheless, sometimes you must set up accurate timing loops or control I/O devices directly. To meet this need, almost all FORTH systems include an appropriate assembler — that in MMSFORTH is for the 8080, but if you pay extra you can get a Z80 version. The beautiful (?) thing about FORTH assemblers is that they are just as interactive as any other element of the language.

FORTH words are defined in assembler terms in a way that is very similar to a colon definition. For example an MMSFORTH segment to whiteout the screen is:

```
CODE WHITEOUT  DE PUSH HL PUSH 1024
               DE LXI 15360 HL LXI

          BEGIN 191 A MVI A M MOV HL
                INX DE DCX D A MOV E
                ORA =0
          END

          HL POP DE POP
     NEXT
```

As soon as you ENTER, this is assembled and the new FORTH word WHITEOUT gives access to the code. You can try it out instantly by typing WHITEOUT, or you can incorporate the new word into any additional 'conventional' FORTH words.

I won't go into any more detail on FORTH assembly programming, but it is worth noticing three things about the definition above:

a. CODE...NEXT are the ASSEMBLER DEFINING WORDS corresponding to [:...;] brackets.

b. The language uses mainly Intel mnemonics, but in an RPN format.

c. The conditional jumps use non-standard mnemonics and FORTH conditional tests.

Incidentally, a much easier definition of WHITEOUT is:

```
: WHITEOUT  191 15360 1024 FILL ;
```

Use Of The Stacks

We know by now that FORTH is a stack-based system. In fact, it actually uses two stacks. The most important one for the programmer is the PARAMETER STACK — that's where data goes and is operated on.

The second stack is the RETURN STACK and holds the return addresses, loop counters, etc that the system needs as it goes up and down the dictionary. In effect, it is equivalent to the single stack assembly-language programmers will be familiar with. The advantage of using two stacks is that variables and control information are firmly separated, with a consequent reduction in the confusion-factor.

Although the return stack is normally transparent to the programmer, it is possible to push and pop data onto and off it. The [<R] word takes the top item off the parameter stack and moves it to the return stack, while [R>] moves a word in the opposite direction. In both cases, the word is removed from the source stack. When we studied the DO...LOOP last month we met [I] which copied the loop index on to the parameter stack. In fact, [I] can be used at any time and will put a copy of the top number on the return stack on to the parameter stack, without altering the return stack. If you like, [I] is equivalent to:

```
<R DUP R>
```

Normally, there is not a lot of call for <R and R>, except to gain access to a number buried several layers down the parameter stack. For example, a word to print the fourth item on the stack would be:

```
: 4PRINT <R <R <R . R> R> R> ;
```

It would, however, be pretty clumsy programming to get yourself into this position.

Just as in assembly programming, you must be very careful how and when you move data to or from the return stack, since it is very easy to corrupt return addresses and so crash the system. As a general rule, if you take something off the return stack you must replace it within the same word and vice-versa.

Useful Words

We have now met many of the common 'standard' FORTH words, but there are a few more which can provide some very useful functions:

[1+] This word simply adds 1 to whatever number is TOS; it has a counterpart, [2+] which adds 2. Their advantages are that they take up slightly less memory and run slightly faster than the equivalent [1+] and [2+].

[2*] You will not be surprised to read that this word doubles the TOS. [8*], [16*] and [64*] act in much the same vein. Once again, they economise (slightly) on memory and run time, although you

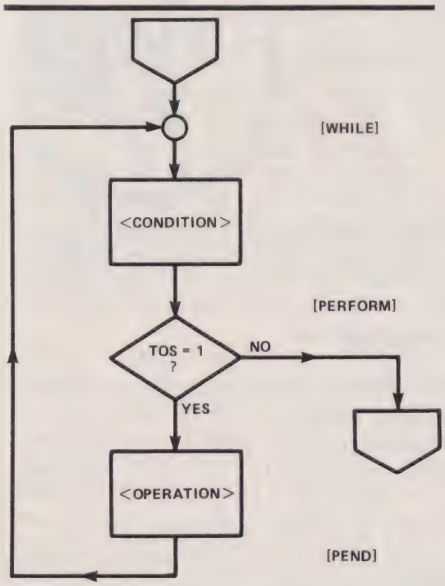

Fig. 2. Another 'structured' construct available in FORTH is the WHILE...PERFORM...PEND function.

would be very hard-pressed if you needed such economies.

ABS This word simply converts the TOS to its absolute value (ie it makes negative numbers positive).

FILL This word is very useful for loading blocks of memory with any given value. It sets the <TOS> bytes of memory starting at <2OS> to the value that is third on stack. For example, to draw a narrow line along the top edge of the TRS-80 screen, you could use:

```
131 15360 64 FILL
```

This loads 131 into the first 64 bytes of the screen memory.

MAX The FORTH word, MAX, takes the top two numbers on the stack and replaces them with the larger; the smaller is DROPped. If the numbers have the same value, one is discarded.

MIN This word works much like MAX, except that it leaves the smaller (ie most negative) on the stack. Together, MAX and MIN provide an easy way of inputting a number and forcing it to lie in a given range:

```
: GETNO " INPUT 1-20" #IN 1 MAX
20 MIN ;
```

Figure 3 shows the working of GETNO if the actual input number is 25; you can see that it leaves 20 on the stack.

MINUS MINUS simply changes the sign of the TOS. It effectively has the colon definition:

```
: MINUS  -1 * ;
```

MOD If you want to divide 2OS by TOS and leave the remainder, then MOD is your word. For instance, to see if a number is divisible by 64:

```
: DIV64 DUP 64 MOD Ø= IF " DIVISIBLE"
THEN ;
```

The FORTH word **["]**, which must be followed by a space, prints the following characters on the terminal until the next **["]** or the end of the line; in this case, it simply prints DIVISIBLE. Figure 4 shows the action of DIV64 when applied to a TOS value of 192.

NOT NOT simply reverses the truth value of TOS, leaving '1' if the TOS was zero. It has exactly the same effect as **[0 =]**.

SPACE To output a space to the screen, use SPACE. On its own, that is not a lot of use, but its extension SPACES will output <TOS> spaces. The colon definition of SPACES is effectively:

```
: SPACES Ø DO SPACE LOOP ;
```

Programming In FORTH

In next month's article, I will give a listing for a FORTH version of the classic computer task of solving the 'Towers of Hanoi' problem. Before then, however, let's take a look at some of the essential differences between programming in FORTH and 'conventional' high-level languages.

Variables. A key feature of FORTH programming is that variables are held in the stack and not in named locations. Nevertheless, life can get very complicated if you are trying to juggle more than four or five numbers on the stack and a few carefully chosen variables can make a program much easier to write and to follow.

However, good FORTH programs use relatively few variables and these are largely used to store the numbers not being manipulated at a given time. Furthermore, the variables actually saved by name will almost certainly be only those which hold the information which the program is manipulating, rather than all the other needed to control the program.

Think about the BASIC programs you write. You will probably find that the majority of the variables are dummies, loop counters, buffers, etc; in FORTH programs, numbers in this class will generally exist only as transient data on the stack(s).

Techniques. Remember that FORTH is a structured programming language and that, to make a program easy to follow, word definitions should be kept short (seldom more than two or three lines long). When taken together, these two aspects of the language make it very difficult to avoid top-down programming, I am glad to say.

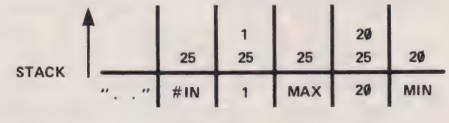

Fig. 3. This is the GETNO operation as seen on the stack.

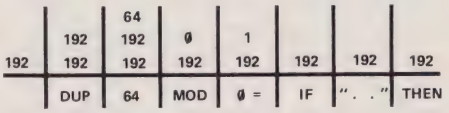

Fig. 4 The DIV64 operation as it runs through the stack.

Start to write a FORTH program with a single word which will represent the final program; define this word from a few other suitable words, eg:

```
: PROGRAM INIT BEGIN 1Ø Ø DO CONVERT
LOOP MORE? END ;
```

That defines a simple program which sets itself up (via INIT), converts something to something else 10 times and then goes to see (via MORE?) whether any more conversions are needed.

Having set up the outline of the program, you can go on to define the new words you used, eg:

```
: MORE? CR " ANOTHER RUN?" KEY 89 =
NOT ;
```

What does that word do? First of all it throws a line; having done so, it asks a question. The next word, KEY, is another standard FORTH word — it puts the ASCII value of the next key to be pressed on top of the stack. The input value is compared with 'Y' (ASCII 89), and NOT reverses the truth test value so that a response of 'Y' leaves '0' on the stack to force a jump back to BEGIN.

Easy isn't it? Obviously, you would also define INIT and CONVERT and any new words you might use in them, and so on.

Up to this point, you should have been working with pencil and paper, because your draft program will have its highest level word **['PROGRAM']** at the top, and its most fundamental words at the bottom. You must, however, enter the program from the bottom, because each word must have access to all the words it uses before it can be compiled itself. It is thus virtually impossible to write any practical FORTH program at the keyboard, which is probably not a bad thing since it forces you to think about what you want to do. The ease with which working BASIC program can be written directly from the terminal is one of the reasons that there are so many badly-structured BASIC programs about!

With a large and/or complicated program, it is not necessary to prepare it all before you start to enter it to the system — sometimes, you won't even be able to. Because the language is so modular, it is easy to use dummy words in some places while you are developing other parts of the program. The dummies do not need to do any processing, but should show that they have been called and, if appropriate, input

suitable data to make the rest of the program work. For instance, in the example above, we could use:

```
: INIT " INITIALISATION ROUTINE
CALLED" CR ;
```

and:

```
: CONVERT " RUNNING CONVERT NOW" CR ;
```

while we were making sure that MORE? worked. Having sorted MORE? we could, perhaps, go on to get CONVERT running properly, etc. A step-by-step approach like this makes program development much easier.

As you enter your program, FORTH's highly interactive nature lets you test each word in isolation. Because it is so easy to test every detail of the program, debugging time is usually very much shorter than it is with BASIC. On the other hand, effective FORTH programming demands a much more careful design approach than you can get away with in BASIC. On balance, once you are used to the language, it is much quicker to design and fully debug programs than it is with more traditional languages.

Remember then, that while it is always important to plan a program carefully before you sit down at the keyboard, the effort is particularly valuable in FORTH.

Layout. Any sensibly-sized program will normally occupy several screens of source code. However, because this code will be compiled, you do not have to concern yourself with RAM space and run-time as you do with BASIC. Indeed, the program will be much easier to follow if you:

a. Use meaningful word and variable names — 'A-PLAYER-SCORE' is much more helpful than 'SA'.

b. Space out the definitions so that they are easy to follow. If appropriate, indent loops, etc to make the nested functions stand out clearly.

c. Use plenty of helpful comments, particularly where you are doing complex stack manipulation. The word **[(]** defines the start of a comment field, which is terminated by a carriage return or a **[)]**. If you must use brackets within the comment, then MMSFORTH allows you to start the field with **[(")]** and end it with **[")]**. You can put comments anywhere in a screen, but it is a FORTH convention that the first line is always a comment briefly describing the function of that screen:

```
( SCREEN 80  1 OF 6  TOWERS OF HANOI 29/9/81)
: TASK ;  ( DEFINE PROGRAM START IN DICTIONARY)
```

d. If you are using a disc-based system, then it is easy to modify any screen during program development. However, in a tape-based system like my version of MMSFORTH, you have to be a little more careful in your planning, since it is tedious to swap screens between tape and memory.

Because MMSFORTH holds two screens in memory at once. I find it easiest to develop a program in pairs of screens, arranging the definitions of group-related words into the two screens in memory at any given time.

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The listing in next month's article will demonstrate the application of these principles.

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BBC USER REPORT

Just how good is the BBC's new computer system? We took one of the first production Model Bs and installed it in our reviewer's home. This report is the result of many weeks of testing and usage. The verdict — read on!

The idea that the BBC should produce a micro is a strange one. After all, the Beeb have failed to make any noticeable impact in the field of radio or TV manufacture — for example, where is the BBC television? However, if you look back into the history of broadcasting, today's venture into modern technology looks more reasonable. When radio was experimental, the BBC did much for its development by publishing designs for receivers, etc. Even today the BBC sets the standard for various pieces of electronics, simply because it is assumed that if the BBC use it, it must be the best! The question is, can this assumption be carried over to the BBC micro? It is certain that the use of the BBC's name would give a great deal of credibility to any microcomputer, whether it be good or a disaster! Is the current product worthy of the BBC's name?

The Beginning

The story of how the BBC came to the decision to adopt a micro and how they found their way to the particular machine they eventually adopted, is a tale that will become part of the folklore of computing. Put simply, what happened was that the BBC decided that they would produce a series of programs about the microcomputer and computing in general and felt that it would be desirable to link the series to the use of a particular micro. It should be obvious that the chosen micro would suffer severe sales problems — namely, they would keep running out of stock! The BBC could not have selected any of the existing dozens of micros for reasons explained last month, so they chose to produce a new machine to add to the fairly full market. A specification was drawn up around the end of 1980 and manufacturers were invited to tender for the contract to produce the BBC micro. The specifications immediately ruled out a number of very popular machines quite explicitly. For example, the need for a 'real' keyboard ruled out the ZX81 and the requirement for the power supply to be other than switch-mode ruled out the APPLE.

At about the same time as the BBC were developing their specification, Acorn Computers were developing a successor to their very popular ATOM. Although they had only reached the prototype stage, the machine impressed the BBC sufficiently for them to drop one of their specifications (for a Z80 CPU) and accept Acorn's machine, 6502 CPU and all!

The machine that Acorn had been working on was to have been called the PROTON, which would have been a good name for the follow-up to the ATOM. How much the resulting machine — the BBC MICRO — owes to the BBC is difficult to say, but its debt to the ATOM is great.

An Overview

Before I go any further, I should say that I think the BBC micro is the most exciting and versatile micro I have seen to date. High resolution colour graphics and sound effects are standard features in a machine which costs less than £250! Of course it has faults (doesn't everything?) and I will point these out as I go along but all in all it is the machine at the top of my list of 'best buys'! To find out why read on . . .

The BBC micro is sold in two different forms: the Model A, a basic 16K machine costing £235, and the Model B, an extended 32K machine retailing for £335. The Model A machine as just stated, comes with 16K of RAM and a sound effects chip. However, as mentioned earlier, high resolution graphics in colour are also a standard feature (ie you don't have to buy any extra ROMs or colour boards), so even the basic Model A out-performs other machines in the same price bracket — for more details see the section on graphics. It is important to realise, however, that these two models are entirely a sales convenience and that the 'A' can be converted to the 'B' by the addition of the extra chips (at a cost of about £135). There could be hundreds of versions of the BBC micro depending upon which options are installed. In the Model B, for example, there is (in addition to the extra 16K of RAM) a serial printer interface, a parallel printer interface, an eight-bit user port and a four channel A to D convertor. Even this does not exhaust the expansion possibilities of the unit because there are areas for a floppy disc controller, a speech synthesiser and an Econet interface — but more of these later. To complete the picture of an expandable machine, Acorn have introduced an expansion bus connection and an interface of their own invention called the 'Tube'. Through the Tube it is supposed to be possible to connect other microprocessors to handle tasks such as language compilers, etc. Only time will tell if these super expansion possibilities are taken up.

The overall appearance of the BBC micro is smart — as can be seen from the photos. The case is made from lightweight plastic and is

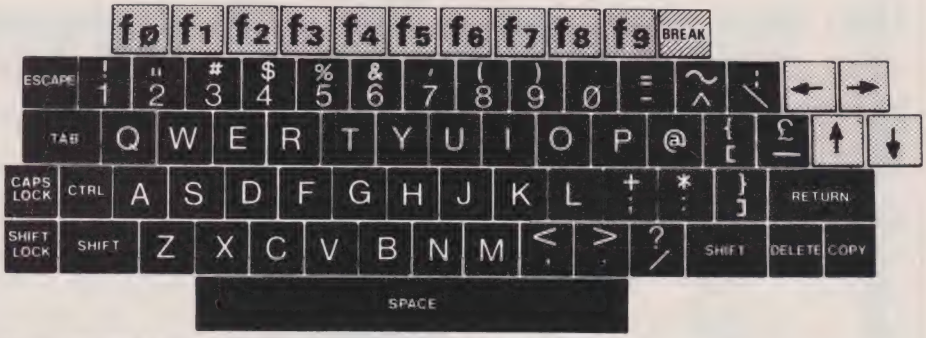
adequate for most environments (but don't try standing heavy weights on it, eg TV monitors). One of the most amazing things about the unit is its size and weight. For a machine with the expansion capabilities outlined above, it is very small and light, measuring 16" by 13", about 2.5" thick and weighing approximately 9 lbs. If you're interested in getting inside the case, then Acorn have made it easy — just four screws and the whole top lifts off giving very good access.

The machine is a pleasure to use. The keyboard feels good and has an auto repeat facility and three separate keys to provide upper case characters; Shift and Shift Lock giving upper case on all the keys; and CAPS Lock giving upper case on letters only. An additional row of user definable function keys are included and these are very easy to control from the software. Five keys are included for screen editing, the usual four cursor keys and a key marked COPY. My one complaint is the layout of the cursor keys. It would have been nice if they could have been positioned like the points of the compass rather than left/right, up/down. However on a keyboard of this size I don't see how it could be done.

The display quality is remarkably sharp on the few TVs I've tried it out on — it should be excellent on a monitor (***It is! Ed.***). One small problem is that on some sets the top line of the display vanishes outside the frame and on others the bottom line does the same. This is due to the rather complete use that the machine makes of the screen; however, it is fairly easy to remedy this 'fault' by adjusting the height control on the TV. The cassette system is very easy to use and keeps you informed of exactly what is going on. In use it is about as good as a cassette system can be and has the handling characteristics of a very slow disc! (In case anyone is in doubt this ***is*** a compliment.)

The Hardware

After our brief overview, the time has come for a detailed examination of the hardware. This is more difficult than usual because of the lack of any technical documentation — or sensible documentation of any kind! Because of this, some of the comments that I will make have the status of informed guesses and I apologise to Acorn in advance for any errors. The review model I've examined was a B machine but all my comments would apply equally to the A version.



The keyboard in close-up.

Construction: I have already said how much I like the mechanical construction of the machine and how easy it is to get inside. If you do venture inside, the sight of the internal layout should be enough to please even the most discriminating. All the chips on the main (only) board are socketed and neatly placed. The power supply is the small black box to the left of the case. The keyboard is fitted at an angle and slightly covers the main board. This should cause no problems as the keyboard can be removed by undoing two bolts and unplugging a short ribbon cable. Also mounted on the keyboard is a small loudspeaker for sound effects and the CHR$(7) 'bell'. The PCBs are well made; the main board is double-sided and printed with the names and locations of all the components. There are signs of last minute modifications in the form of a number of fine wire jumpers and cut tracks on the bottom of the board. Not too much to worry about though, they will probably vanish in the second edition. A slightly more worrying problem is the poor support of the main board. It is fixed at four points and flexes if you try to remove or insert a chip into its socket. This may not sound like much of a problem until you notice that all but one of the I/O connectors are also mounted on the main board, so plugging and unplugging causes a similar flexing of the board.

The power supply: This, like the rest of the machine, is remarkable! A small black metal box about 6" by 3" by 2" contains all the necessary hardware to supply the fully expanded main board. A power supply of this size would normally have to use a switch-mode design. A switch-mode power supply is used in the Apple, for example, and was the main reason for the Apple's small size at a time when most other machines were huge. The BBC micro uses a conventional step down, rectifier/regulator circuit, however, and consequently runs VERY HOT. I can honestly say that of all the power supplies I've had the pleasure to feel, this one is the hottest! If it had a non-stick finish you could fry an egg on it!

The reason why Acorn have gone to so much trouble to avoid using a modern (more efficient and hence cooler) power supply is that the BBC's original specifications rule out the use of switch-mode power supplies. Why? Well the reason must be that someone at the Beeb thinks that switch-mode supplies put out too much radio interference. This would be true of a badly designed supply but does not provide a good reason for damning the whole principle — an unshielded computer (eg the BBC micro) puts out far more interference than a well-screened switching power supply. To be fair to Acorn, they have tried hard to design a good supply by using a toroidal transformer which, in general, is more efficient, smaller and more expensive than conventional types. Although I have had no trouble with this supply, I find it the least attractive feature of the machine.

The main board: This section is really a description of the computer itself as nearly everything fits on the main board! The microprocessor used by the BBC micro is a double speed (2 MHz) 6502. This is a fairly ancient processor by today's standards and was previously ruled out in the BBC's earlier specifications. So why does it turn up at the centre of the machine? The reason is that, although it's easy to design a brand new computer using almost any microprocessor you care to name, it's not so easy to produce software for it. Acorn had already used the 6502 and invested time in their own BASIC interpreter which in turn

could be used to speed the development of the new BASIC interpreter the BBC micro required. The advantages in using the 6502 again were clear.

The main board is divided into a number of functional areas (see Fig. 1). The RAM area contains eight or 16 dynamic RAM chips (4816) socketed so servicing should be easy. The ROM area on my machine contained not five ROMs, but one ROM and four 2732 EPROMs. The BASIC is contained in the massive 128Kbit ROM. The four EPROMs currently contain the Machine Operating System (MOS). In later versions this will be put into another 128Kbit ROM.

What becomes of the three spare sockets, I hear you ask? The answer is that four of the ROM sockets are paged and can be used for 'alternative' software. For example, a disc operating system ROM could be installed and could be switched in to replace the BASIC ROM under software control.

Moving away from the memory area we come to the video processor ULA. ULA stands for Uncommitted Logic Array and is essentially a method of producing a large-scale integrated circuit for a reasonable cost. Put another way, this means that there are two chips inside the BBC micro which have been designed by Acorn (and produced by Ferranti). The video ULA is responsible for most of the clever colour graphics the machine is capable of and that's about all I can say without more information from Acorn. It is certain that the use of this ULA is what makes the BBC micro able to offer such good graphics for such a low price.

The Storage Solution

The cassette system for the BBC micro is, as I have said before, very easy to use. It is also ***very*** reliable. The secret of this good-natured storage is the second ULA in the machine — the serial processor. The serial processor is responsible for handling the coding of the cassette data and contains a digital clock/signal separator making it a complete signal processor. The use of a digital separator makes data recovery fairly independent of speed and volume fluctuations found on low-cost cassette recorders. Two record speeds are available: 30 characters per second using a standard CUTS format, and 120 characters per second using a CUTS-related but non-standard format. Both work!

The cassette recorder is connected to the back of the machine via a standard 7-pin DIN audio socket. Acorn don't provide a completed cable (it has bare ends for connection to the recorder) on the basis that they could only cover 308 of the types of connector with one lead. This is a pity because it means that it is not possible to unpack and run the demonstration programs without first soldering on at least one plug.

The software used to control the cassette is clearly based on the ATOM cassette system. Named programs (up to 10 characters) can be saved and loaded. The format used for writing the tape is such that if an error occurs, it can be isolated to a particular block. The tape can be rewound and restarted at any earlier time. The first complete block found gives the name of the program and the block number. This information is used to continue the load so that it is not necessary to go right back to the start of a bad load — just re-read the blocks in error. The cassette can be used to save and load data under program control but more of this later.

The one problem with the cassette system is that only one recorder can be used. Acorn tell me that future production machines will be equipped to control two recorders but only reading from one and writing to the other. This may sound like a serious limitation but would, in fact, suit most applications requiring two cassettes.

Graphically Speaking

This is certainly the single most interesting feature of the BBC micro. There are, as always, two aspects of graphics — the hardware used (which determines the resolution) and the software — provided to make use of the hardware. The graphics hardware can work in eight distinct modes; see Table 1

Mode	Graphics	Colours	80x32	Memory	Model
0	640x256	2	80x32	20K	B
1	320x256	4	40x32	20K	B
2	160x256	16	20x32	20K	B
3	—	2	80x25	16K	B
4	320x256	2	40x32	10K	A & B
5	160x256	4	20x32	10K	A & B
6	—	2	40x25	8K	A & B
7	Teletext	16	40x25	1K	A & B

Table 1. The graphics modes and what they give you.

Examining Table 1 reveals a number of details. The highest resolution graphics is a remarkable 640 by 256 plotting points — this sort of resolution would have cost more than the entire machine a year ago! A standard (commercial) format 80 by 25 screen is available only on Model B. The memory used by each mode is taken from user RAM — not a special display memory; only the

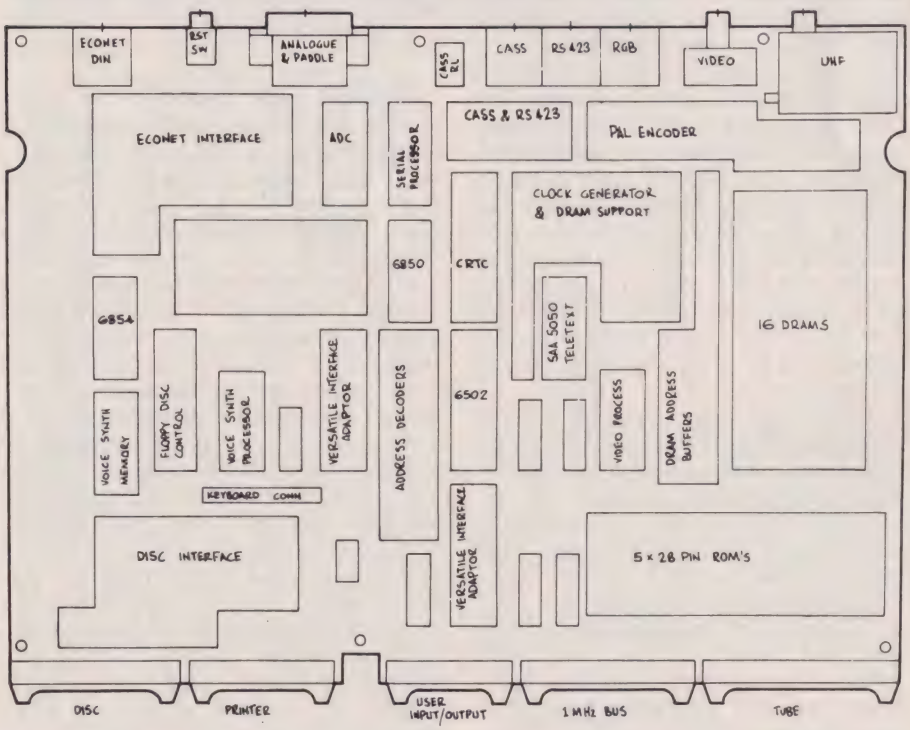


Fig. 1. What lives where on the main PCB.

last four modes are available on the Model A because of the memory requirements.

As mentioned earlier, the graphics are produced mainly with the help of the custom-built ULA chip. However it works; it must be receiving data from the user RAM and then re-arranging it to represent the required screen format. For example in Mode 0, each bit of the user memory corresponds to one screen location (pixel), but in Mode 1 you need two bits to determine the colour of each pixel. The ULA is responsible for collecting the number of bits each pixel requires and then determining which colour it should be. An area of memory inside the ULA is used as a 'palette' — in the sense that it associates the codes stored in user memory with 'real' colours. For example in the two-colour mode, zero could be black and one could be white but by re-programming the palette you could have blue and cyan! One last detail about the graphics ULA is that it accesses the user memory in between the read/write cycles of the 6502 so the graphics display doesn't slow anything down.

Colours may be selected from any of those shown in Table 2. In use, these colours are clear and the overall display effect is stunning.

Foreground	Background	Colour
0	128	black (normal background)
1	129	red
2	130	green
3	131	yellow
4	132	blue
5	133	magenta (blue-red)
6	134	cyan (blue-green)
7	135	white (normal foreground)
8	136	flashing black-white
9	137	flashing red-cyan
10	138	flashing green-magenta
11	139	flashing yellow-blue
12	140	flashing blue-yellow
13	141	flashing magenta-green
14	142	flashing cyan-red
15	143	flashing white-black

Table 2. The colours available and their codes.

Plotting coloured lines in Hi-Res graphics couldn't be easier — just select your colour and plot the line! The result is clearly in the colour you selected — some readers may be puzzled as to why this is so clever, surely this is what should happen? Apple owners, on the other hand, will think the BBC micro very clever!

The trouble with having all of these advanced graphics options is that it's all too easy to miss commenting on the less exciting things. So let me say, before I forget, that upper and lower case characters are present on both models; the text characters can be user defined (except for Teletext Mode 7) and text and graphics can be freely mixed on the screen. From the point of view of the hardware, text is just predefined graphics!

It is worth pointing out that the BBC micro is capable of being used to display the block graphics characters (or at any rate, something very close) of other machines. This would make converting programs which make use of specific graphics features very easy; not that there are some limitations to this idea — the BBC micro works with an 8 x 8 dot character block. The one slightly annoying feature of the graphics set is that the Mode 7 character set does not have a 'slashed' zero. As this is the mode in which you generally operate, the system boots up in Mode 7; confusion can occur until you get used to this.

There are three video outputs on the back of the machine: one mixed video (BNC connector), one RGB (6-pin DIN) and one UHF modulated output (Phono connector). The only one that I've used is the UHF modulated output.

User Interfaces

I've used the term 'user interface' as a way of collecting together the 'odd' interfaces which don't really fit into any other category.

Starting with what is usually referred to as a user interface, the BBC micro has an eight-bit parallel port. This is simply an unbuffered 'B' side of a 6522 PIA chip so it should be very familiar to anyone with a PET. Not all of the lines are available for unrestricted use for example, the CB1 line can also be used as a light pen input. Connection is made to the user port by a 20-pin ribbon cable plug mounted under the cabinet.

The other half of the PIA is used as a parallel printer port. The standard seven data and two handshake (busy and strobe) connections are provided on a 26-pin ribbon cable plug also mounted under the cabinet. Presumably Acorn will provide cables for most printers.

A serial printer interface is also available using a standard 6850 ACIA. The only control lines provided are RTS and CTS and these may be found on a five-pin DIN socket at the back of the machine along with (of course) data-in and data-out. The use of a five-pin DIN socket may cause some trouble if you're trying to connect a standard (RS232 or V24) piece of equipment which uses a 24-pin D connector (but then it wouldn't be fun if they made it too easy!). The only other fact which might cause concern is that the serial interface is labelled RS423 rather than the more friendly and usual RS232. Have no fear, I am assured that RS423 is just a 'better' version of RS232 and may be used as if it were RS232.

The sound generator chip is sort of a user interface (computer to air!) so I will deal with it in this section. It is a fairly standard SN76489 sound effects chip containing one noise channel and three independent oscillators. This means that the BBC micro can 'play' up to three-note chords and make a wide variet of other bangs and pops.

The only other interface wh ch comes into the general category of 'user' is the paddle or analogue input interface. Connection to the onboard A to D convertor (a uPD7002) is made via a 15-pin D socket (why use a D socket here and not on the serial port?). Apart from the four analogue input channels, there is also a 5 V supply and a reference voltage. These are obviously going to be used to feed two X,Y joysticks (or paddles as they have become known lately). The light pen connection mentioned in the section on the user port finds its way into the outside world via pin 9.

Down The Tube?

The BBC micro has two machine interfaces, both mounted underneath the case. A 34-pin ribbon plug supplies the '1 MHz Bus' and a 40-pin ribbon plug supplies the 'Tube'. Of the two, the Tube is the one that has attracted the most attention as a method of exanding the system by adding on other processors. It's difficult to say anything precise about either, because Acorn haven't published any technical information, but by examining the names given to the various pins it is possible to make a few guesses and also say what isn't the case. Well, the 1 MHz bus isn't a 'bus' because it only brings out address lines 0 to 7. This suggests that the 1 MHz bus is going to be used to share an area of memory between the BBC micro and some other machine or peripheral. Indeed, if we have a look at the memory map of the MOS (see Fig. 2) there are two areas (called Jim and

Fred !?!?***!), each of 256 bytes, that are designated for the expansion bus. The implications of this are not easy to see but it is obvious that no other micro can gain control of the entire address space of the 6502. This means that alternative CPU cards of the sort used on the Apple (the Z80 Softcard and the 6809 Mill), aren't possible on the BBC micro. However, 512 addresses for hanging extra I/O devices seems reasonable enough.

The Tube is a lot more difficult to fathom. Like the 1 MHz expansion bus, the Tube only provides a subset of the address line — A0 to A6 to be precise. The only control lines provided are Reset, Interrupt Request and the mystery line, TUBE. The way the Tube works all depends on what controls the line, TUBE, from deep inside the machine. It is likely that the add-on processors planned by Acorn will use the BBC micro as not much more than a super VDU. Is this a waste of a good machine? No, it's the birth of a super VDU — try buying a Hi-Res graphics, sound effects etc, colour VDU for less than £350!

The Soft Section

As should have been clear from the hardware section, the BBC micro has its memory space divided into two 32K regions. The bottom 32K is used for RAM and the top 32K is used for ROMs and memory mapped I/O (see Fig. 3). This may seem like rather a lot of ROM for one machine but it is all used to good effect. As well as the superb BASIC, there is an assembler and all the routines necessary for cassette handling, etc. The trouble with having all this excellent software in 28K of ROM is that it does reduce the amount of user RAM. In the worst possible case, with Mode 0 graphics and a disc system, the user might only have 8K to play with! Don't let this put you off — in practice you could always move to lower resolution graphics. It does, however, point to a weakness of the machine — insufficient address space.

The BASIC: The BASIC to be found inside the BBC micro is brand new. It's not Microsoft BASIC but something produced by Acorn themselves. The only other successful micro which has left the Microsoft school is the ZX81 that has a BASIC coming close to the standard set by Microsoft. The BBC BASIC is the first version ***better*** than Microsoft.

Along with the BBC hardware specification came a detailed

0000	to	3FFF	always RAM (16384)
4000	to	7FFF	optional RAM - Model B (16384)
8000	to	BFFF	4 paged Language ROMs (16384)
C000	to	FBFF	Operating System ROM
FC00	to	FCFF	Fred (256) expansion bus
FD00	to	FDFF	Jim (256) expansion bus
FE00	to	FEFF	Memory mapped internal use
FE00	to	FFFF	O.S. Rom

Fig. 2. The memory map, see also Fig. 3.

specification for the BASIC their machine should run. The BBC obviously wanted to make their BASIC academically correct because they would be responsible for introducing a lot of people to programming for the first time and any bad habits picked up would be their responsibility. Some academics were already critical that BASIC rather than Pascal had been chosen. The BBC's problem was that, by introducing new BASIC statements to make it structured like Pascal, they went further away from the ***de facto*** standard provided by Microsoft. The solution was to have as much Microsoft-compatible BASIC as possible and extend it to include the extra statements needed for structured programming.

Subroutines And Procedures

One of the big problems with traditional BASIC is that it has no way of creating 'proper' subroutines. Yes, it has the GOSUB command but this is really only an improved version of GOTO. What is really needed is the ability to write a chunk of program to, say, plot a square at some X,Y co-ordinates and then give it a name such as 'SQUARE' so that saying SQUARE (X,Y) anywhere else in the program causes a square to be plotted. This is ***almost*** what BBC BASIC allows you to do via the DEF PROC statement. For example the procedure ASTK given below will print X asterisks on the screen:

```
1000  DEF PROCastk(X)
1010  LOCAL I
1020  FOR I=1 TO X
1030  PRINT "*";
1040  NEXT I
1050  ENDPROC
```

I could go on for some time explaining all the facilities offered by the DEF and other statements. However, I will confine myself to the observation that this single extension to BASIC means that big programs can be built up from little procedures and this is the first time that this has been possible in a BASIC interpreter.

File Handling

The reason why I've singled out the file handling commands is that this is one of the main areas where things might get difficult if you have to convert a Microsoft BASIC program. The cause of the trouble are the OPENIN and OPENOUT commands which are distinctly different from the better known OPEN command. OPENIN and OPENOUT are functions which return the logical file number as opposed to OPEN which is a command to assign a given logical file number to the file. I leave it to the reader to think of the fun this slight difference could cause.

Graphics And Sound

The graphics commands of the BBC micro are far too versatile and subtle for me to be able to give you anything other than a flavour of the subject. The first clever thing about the graphics is that no matter what Mode you are in, the graphics screen is made to appear 1280 pixels wide by 1024 pixels high. This allows you to write graphics programs ignoring the resolution at which they will finally be used. I've had quite a lot of fun trying out the same program at various resolutions and comparing the differences.

The workhorse graphics command is PLOT. It has very many different functions including plotting a point, a line, a dotted line and even a solid triangle (!), either in absolute co-ordinates or relative to the last plotted point. I hope you noticed the bit about plotting a solid triangle because it's the most powerful part of the Hi-Res graphics commands. The triangle can be plotted in any valid colour and it appears very quickly on the screen. Why

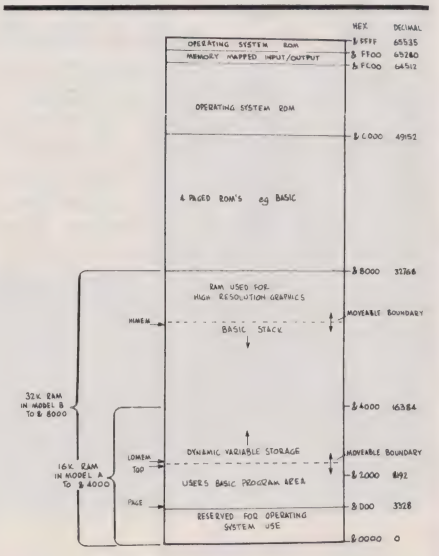


Fig. 3. Another way of showing what goes where in memory.

triangles? Surely rectangles are more useful? No — if you think about it, any shape can be made up out of triangles. In this sense the triangle is to drawing solid shapes what the line is to line drawings!

Other features of the graphics are equally powerful but would take too long to describe. I will simply mention the following abilities: to set foreground and background colours; to plot an image and then, almost instantaneously, change all the colour values; to define a graphics area and a text area on the screen which can be cleared independently; and finally, to test the colour value of any pixel, etc. In short, there is not much you cannot do and most of it can be done from BASIC!

Before rounding off the description of the BASIC, I should mention the sound command. Its syntax is:

```
SOUND channel,vol,freq,duration
```

Channel can be from 0 to 3 with 0 as the noise channel, volume from 0 to −15, frequency from 0 to 255 and the same for duration. The fun part of this command is that the three tone channels can be used at the same time. So:

```
SOUND 1,-15,20,50:SOUND 2,-15,100,50:
SOUND 3,-15,200,50
```

is a three note chord — have fun!

There are many other features of the BASIC making it enjoyable to use; such as long variable names, good (Microsoft style) strings and string functions, a renumber command, etc, etc. But I would be leaving out one of the delights of using the BBC micro if I didn't tell you about the screen editor! There are two cursors — the text cursor and the editing cursor. The text cursor is the standard 'this is where you're typing' marker but the editing cursor can be moved about the screen using the arrow keys without any effect on the text cursor. If you press the key marked COPY however, whatever is under the editing cursor appears under the text cursor as if it has been typed from the keyboard (both cursors then move along to the next character). You can stop copying an old line on the screen by letting the COPY key go and then changing or adding to it by typing from the keyboard. It's not the most powerful screen editor but it is easy to use.

The Assembler

One of the best features of the ATOM was the way in which assembly code could be mixed with BASIC. The BBC micro has carried on this tradition by including an even better assembler in ROM. It's so easy to mix assembler and BASIC that I have a feeling that in the future I will be switching from one to the other without making my usual fuss. The best way to illustrate how easy it is, is via an example:

```
 10  DIM Z% 30
 20  P%=Z%
 30  [OPT 3
 40  PHP
 50  LDY #&FF
 60  SEI
 70  STY &FE43
 80  STA &FE4F
 90  INY
100  STY &FE40
110  LDY #&10
120  .WAIT DEY
130  BNE WAIT
140  LDY #&08
150  STY &FE40
160  PLP
170  RTS
180  ]
190  PROCnoise(RND AND &DF)
200  GOTO 190
500  DEF PROCnoise(C%)
510  A%=C%
520  CALL Z%
530  END PROC
```

Line 10 saves 30 bytes of storage for the forthcoming machine code; the address of the start of this space is put into Z%. The variable P% is the program counter, so line 20 starts the assembly at the top of the reserved space. The brackets [and] are used to enclose any assembly language so everything from line 30 to line 180 is assembly language. If you know 6502 assembly language then lines 30 to 180 will be familiar to you even if you don't know what they do. Notice the use of the label WAIT at line 120. When the program is run, a listing of the machine code produced by the program is given along with any errors (there shouldn't be any in this case). The listing can be suppressed when everything is OK using the OPT statement. To use the machine code produced, it is a good idea to define a BASIC PROC with a suitable name rather than just use a nameless CALL command. PROCnoise is therefore defined in lines 500-530 and all you need to know about this is that a CALL statement sets the A,X and Y registers of the 6502 to the *lower* bytes of the variables A%, X% and Y%. What does it all do? It makes random noises from the sound effects chip!

A Welcome Home?

This is going to be a short section — there isn't very much documentation! To be fair to Acorn, the "User Guide" does have 'provisional' all over it but my main source of frustration while using the machine has been a severe information shortage. The detective work has been enjoyable but just think how much more I could have told you about the BBC micro if Acorn had only told me . . . ? I can't wait for the real thing (manual that is). (***The first 6000-odd machines will be supplied with the provisional manual containing a postcard to be filled in and sent to the address provided. When the new manuals are completed, the BBC will send you one free of charge. Ed.***)

The word 'Welcome' in the heading may lead you to believe that there has been a printer's error and this bit should have come first. In fact 'Welcome' is the title of a package of programs which come with the BBC micro just to show you what can be done. It comprises a cassette tape and a booklet and is excellently produced to show off many of the features of the machine. It is remarkable that a compilation of such extent and quality should be given away free with every BBC micro.

The Future

For the BBC micro the future must surely be good. Without looking too far ahead there is to be the addition of a disc system and among some of the other planned extras are a Prestel interface, a Teletext interface, a second processor connected via the Tube, either another 6502 or a Z80 running (ugh) CP/M, a 16-bit processor.

It's not really possible to come to any other conclusion about the BBC micro except that it's excellent and certainly worthy of its prestigious name. A feature it shares with the BBC is that it is an all-British product; designed by Acorn, it is being built by ICL and Cleartone with custom-built chips by Ferranti. It is well ahead of all currently marketed machines and has a clear price advantage. As far as I'm concerned, Acorn's new micro is an exciting departure for the BBC.

STOP PRESS

Just before this issue was sent to the printers the BBC announced that owing to the increased costs of production, components and testing the price of the BBC Computers would have to rise. As from Monday 25th Jan all order forms will carry the new prices, £299 for the 'A' and £399 for the 'B', but orders on existing forms will be honoured at the old prices until the end of January.

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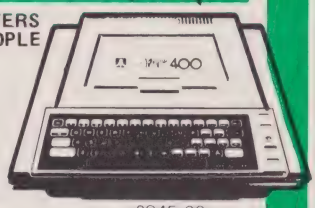

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D S Peckett

Continuing our look at some of the low-cost training aids on the market we booked in for a session with the Micro Professor.

Four years ago, in microcomputing's prehistory, I first came across a wonderchip in the shape of the Motorola MEK6800 D2 development kit. This was a microprocessor evaluation and training aid, based around a 6800, incorporating a fairly simple monitor and no less than 256 bytes of RAM. Programmed in Hex and used as part of a training course, it was a good introduction to the inner workings of micros.

I was, therefore, particularly interested to receive the Micro-Professor (that's an awful name — I'll call it the MPF) for review. The MPF is advertised as a 'microprocessor training tool for students, hobbyists and personnel' (sic) and this review takes a look at just what you get for your money. The review will be slightly different from the normal sort of evaluation since it will not only take a look at the MPF, but also study how well it is suited to its purpose.

What You Get For Your Money

The MPF package is distributed by Flight Electronics of Southampton, priced at £54.95 including VAT but not P&P. For your money, you get a Z80-based micro based around a Hex keyboard display; the system is programmed in machine code, not BASIC. You also get a thick manual covering most, but not all, of what you might want to know about the hardware details and includes the training element of the package. Finally, there is a mains power supply for the system.

In ZX81 terms, you do not get a lot for the money, but by any other scale I consider that the package is well-priced for what is included.

The MPF hardware itself measures 220 mm x 153 mm, including the 36-button keyboard and display. The system is very neatly assembled on to a good quality gold-plated PCB and the standard package also includes a loudspeaker and a cassette interface for program storage. The RAM can be expanded to a possible maximum of 6K although I cannot imagine anyone wishing to enter and debug that much Hex code. The system I reviewed included a PROM, containing some demonstration programs, in the memory expansion area. The whole package is tidily housed in a plastic pseudo-book which opens out giving access to the system.

There is also space to add Z80-CTC (Counter-Timer Circuit) and Z80-PIO (Programmable I/O) chips to the system in order to perform more complex tasks. The board incorporates connectors to the Z80 and PIO busses and a useful breadboard area for wiring in extra components; the manual, however, gives no indication of how to use these facilities.

The system power supply is a 9 V DC, 500 mA unregulated source, built in to a mains plug feeding an on-board 7805 regulator. All very straightforward except that I was supplied with a German (DIN) standard 2-pin mains plug which I was only able to use via my razor adaptor! Since this plug incorporated a 220 V, rather than 240 V, transformer and the system drew the full 500 mA, things tended to run rather hot. I trust that future copies of the MPF will have UK-standard power supplies.

Monitoring The Situation

The monitor program contains the usual facilities such as inspection and alteration of the data in any address, setting and clearing of (only one) break point, single stepping, system reset, etc. It also allows you to inspect and load any of the Z80 registers and has a useful memory block move routine. There is also a neat facility to calculate and insert into the correct place, relative displacements for the Z80's JR and DJNZ instructions.

Finally, there are tape read and write routines which seem to work well although I had some trouble setting them up in the first place. The manual does not specify either the input or output signal levels so it was very much a case of trial and error. To be fair though, getting the replay level correct was rather easier than it is with a TRS-80 since the input from the recorder is echoed on the MPF's built-in loudspeaker. Once I had the level in the correct area, I only had to adjust the recorder's volume control until I could hear a clear response from the system. The monitor saves named files on tape (four Hex characters) and will search for any given file; while it is searching, it displays the names of any other files it might come across. Very tidy.

All these monitor functions are very easy to use once you have interpreted the manual (which is not so easy).

The documentation includes, I was glad to see, a complete and very well commented listing of the monitor. However, one aspect of the system I did not like was the monitor's use of RAM. The standard user RAM is from 1800-1FFF Hex with the top 80 or so bytes reserved for the monitor. This is all very well unless you expand the RAM; since the expansion starts from 2000 Hex, the reserved bytes will now occupy a block in the middle of the expanded area. This is rather silly and awkward and could have been avoided by, for example, putting the monitor locations at the bottom of RAM or by expanding towards low addresses.

The system is a Hex-only one. Since it is aimed at learners, to whom Hex may be totally new, it would have been useful to have had Hex-decimal-Hex conversion routines in the monitor. It would be easy enough to add them but if you are good enough to do that, you probably would not need them anyway!

The MPF As A Training Aid

No matter how nice the MPF hardware may be and it is nice, its value as a training aid depends entirely on the standard of its supporting documentation. It is in this area that I believe it to be totally inade-

quate. However, before I explain why, I must outline my personal opinion of training aids of this type (not just the MPF).

I believe that any microcomputer training system which concentrates on teaching students to program at the machine-code level (not even via an assembler) is totally misguided. The approach may have had its value in the very early days of the micro revolution when there was nothing better and it is still relevant to the few engineers who will become system designers at the most detailed level. However, for the vast majority of people who wish to understand micros, it makes the learning task enormously more difficult than it need be.

One of the major weaknesses of micros so far has been the poor quality of software and forcing people to work in machine code without even explaining its limitations can only perpetuate this weakness. Nowadays, high level languages of all kinds are freely available and very few programmers have to work at the lowest levels. Training packages like the MPF can only produce genii at Hex coding who understand little or nothing about the true meaning of the micro revolution; the important areas to concentrate on should be micro applications and effects, not how the devices work at the chip level.

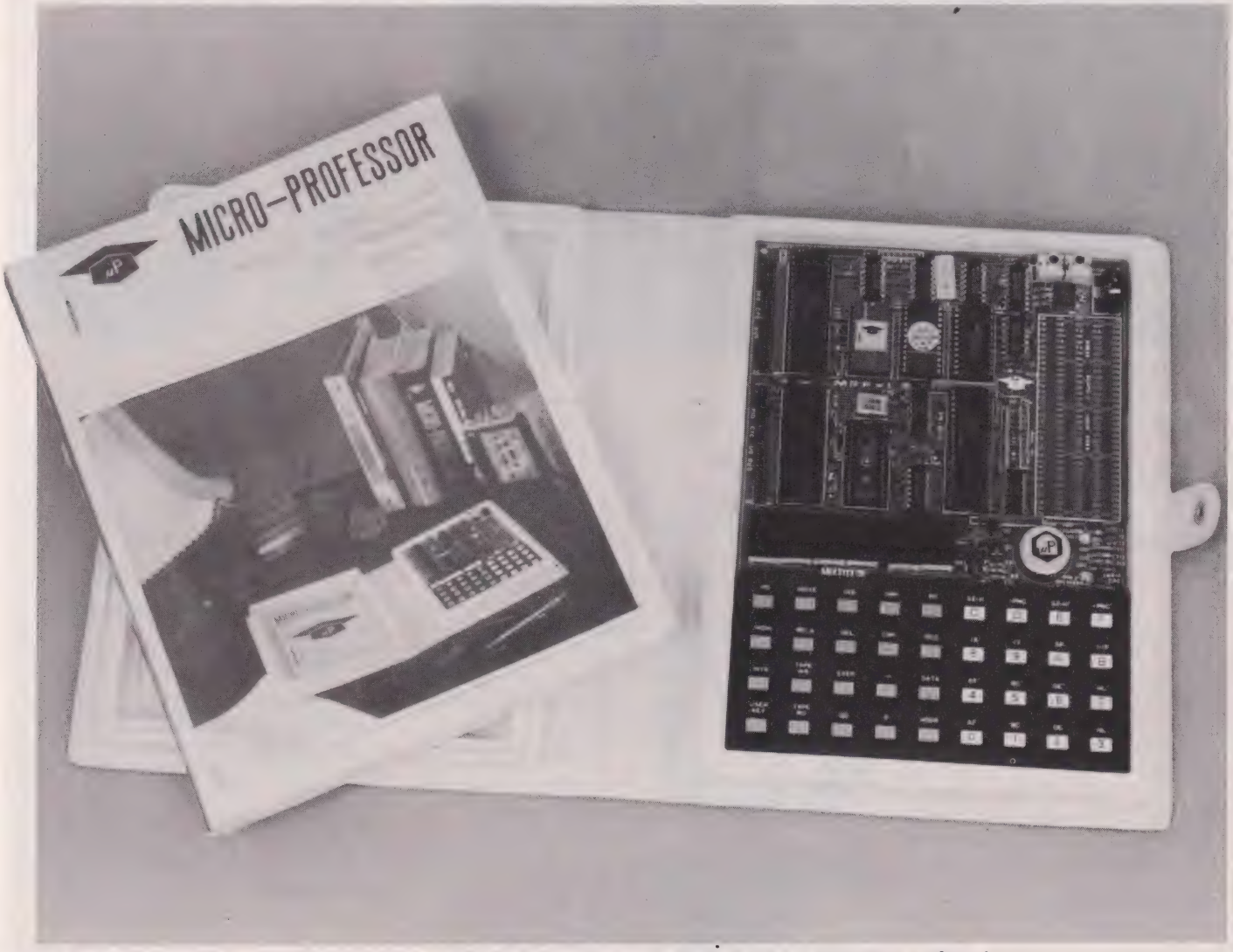
The MPF, then, is an attempt to solve the wrong problem and takes a very old-fashioned approach into the bargain. That said, how well does it handle the problem it actually tries to solve?

I am sorry to have to report that, even on its own terms, the MPF does not succeed. It is sadly let down by its manual, which is poorly structured, oddly translated (the system comes from Taiwan) and full of typographical and factual errors. It even includes demonstration programs which do not do what they are claimed to do.

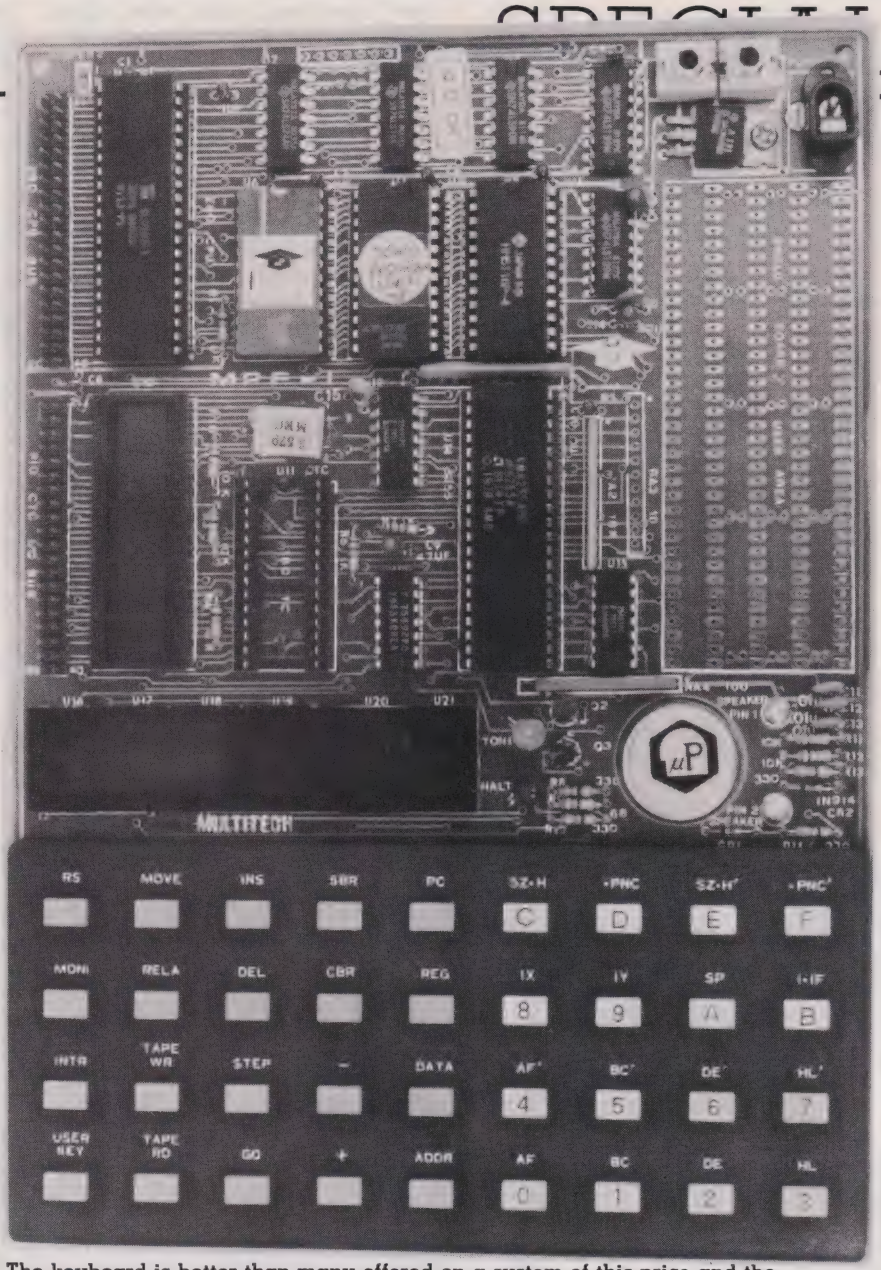
Manual Structure

The single thick book supplied with the MPF serves as a technical manual, a description of the Z80 and an 'Experiment Manual'. The system would be much easier to use if these functions had been separated into a number of physically distinct books. At present, the most detailed technical data is at the start of the book and the poor student must wade through about 170 pages of dense technical and programming information before reaching the training part of the book. Such an approach can only serve to depress the student, since most of the data will be no more than gobbledegook at this stage.

The technical manual starts with a description of the board from the user's points of view and explains how to use the monitor. The description follows a sensible sequence but assumes far too much knowledge of computers and programming in general and the Z80 in particular.



The MPF is certainly packaged attractively — what is not so certain is whether it is an attractive package!



The keyboard is better than many offered on a system of this price and the construction is again above average.

Remembering that the aim of the MPF is to teach about micros, it seems absurd to throw in fundamental concepts like 'address', 'data', 'RAM' and 'register' without first explaining them. They may seem obvious to you microfreaks out there, but, believe me, they are not obvious to someone told 'here is a training package — go and learn about microcomputers'.

The manual then describes a number of useful monitor subroutines and explains the MPF hardware and some of the details of its operation.

The next section of the book is an outline specification of the Z80 hardware and instruction set, together with a cursory description of several of the Zilog peripheral chips such as the CTC and SIO (Serial I/O). There is no attempt whatsoever to explain the significance of any of this information, much of which has no relevance to the MPF anyway. The instruction mnemonics are merely listed, together with their opcodes and the reader is left to puzzle out their full meaning. All the information has been lifted unaltered from the Zilog technical manuals, errors and all, and can only confuse the beginner.

The final part of the technical manual is a listing of the monitor code. As I mentioned above, this is well-commented and very useful to the more experienced programmer.

The Training Course

Finally, we reach the training element of the manual. It follows the traditional sequence of first outlining the concepts of programming, followed by investigations of the basic data-transfer instructions, branches and loops, use of the stack, etc. However, it does not treat any of the subjects in anything like enough depth and omits fundamental concepts.

For instance, if I did not already know how to draw a flowchart, I would certainly not have learnt the art from the manual. The introduction to programming looks only at machine-code programming, concentrating on the Hex opcodes with the implication that, if you are very lucky, you might have access to an assembler. There is no mention that high-level languages even exist, let alone a discussion of their advantages and disadvantages.

Once the manual reaches the 'experiments', the skimpy treatment gets, if anything, worse, with no proper description of what each instruction actually does within the Z80. To be fair, the MPF's designers made a rod for their own backs in basing a training package around the Z80, which is by far the most complex of all the common eight-bit micros.

Later, the manual misses the chance to give some valuable training in the design of I/O routines. There certainly are experiments in the use of such procedures but they make use of monitor subroutines rather than encouraging the student to appreciate the problems of designing his or her own. Some of the experiments make use of the Z80-CTC which is an optional extra in the system missing from the review example and not mentioned in the manual.

Conclusions

The Micro-Professor is a training aid which, to my mind, fails completely to be an acceptable system. Although the hardware is very nice and well documented, the training aspects of the package are completely let down by its manual.

I fear that anyone buying the MPF to learn about micros will be bitterly disappointed; the only way in which the system could serve as a useful tool would be as part of a properly structured and controlled course at a training establishment.

My advice, therefore, is not to contemplate buying an MPF unless you particularly want a cheap, but nicely made, single-board computer with an effective Hex monitor. To use it, you should already have a good understanding of micros.

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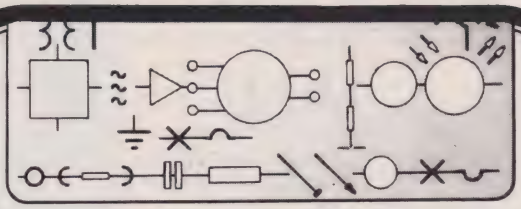

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After taking a month off, the Editor returns to assist those lost in the micro jungle.

So, you thought that I'd given up did you? No such luck! The mailbag has been steadily filling up over the last few weeks and there are some very interesting questions in there to be answered.

If you've written in to #FILE and haven't seen your enquiry in print yet, don't worry, we have more mail to get through than space to fit it in — so it might take a little time.

The Spoken Word

Mr Dodiha of Kenton wrote recently and asked:

What is the nature of the International Phonetic Language which is often found to be used in computers that respond to the spoken word. I have read about UNIFON and ARPABET and I wish to find out as much as I can about them.

I think someone might have been having you on, Mr Dodiha. There are two main ways in which speech recognition is currently done on computers. The first is to pass the speech through a pre-processing system which extracts information as to the frequencies, pitch, etc, etc. This then passes to a host computer as a data word which is then processed and matched against previously stored speech patterns. The second method is to simply (!) to convert the analogue signal to a digital one and let the computer do all the analysis.

The first method has many advantages and looks (in the long term) to be the best solution. However, neither of them use the IPA. This is used to allow the clear understanding of the spoken word over poor quality radio links; for example the police and air traffic controllers use it. I give the list of words below and, as you can see, they merely act as 'spoken mnemonics'.

INTERNATIONAL PHONETIC ALPHABET

A	Alpha	H	Hotel
B	Bravo	I	India
C	Charlie	J	Juliette
D	Delta	K	Kilo
E	Echo	L	Lima
F	Foxtrot	M	Mike
G	Golf	N	November
O	Oscar	U	Uniform
P	Papa	V	Victor
Q	Quebec	W	Whiskey
R	Romeo	X	X Ray
S	Sierra	Y	Yankee
T	Tango	Z	Zulu

Your enquiry about UNIFON and ARPABET raised more than a few eyebrows. I can find no reference to these anywhere. ARPANET is a very large computer network in the USA, perhaps this is what you meant. If anyone can enlighten us on UNIFON I'd be most grateful!

A BBC Pot Pourri

The imminent arrival of the BBC Micro seems to have sparked off a number of anxious enquiries. The first is from Mr Gleur — we think — (it helps if you print your names in capitals!) of Beckenham who writes:

I am just about to start computing as a hobby by purchasing the BBC Model B computer. The BBC advise that program storage may be made on a "standard audio cassette recorder".

Having read many computer magazines, it seems that the make and quality of these standard cassette recorders has a lot to do with the ease and reliability of storing and retrieving programs from cassette.

Could you please comment from your experience on a suitable machine for use with the BBC Micro.

The BBC micro has a very tolerant cassette interface, it seems to be (almost) unaffected by speed changes and the first program on the Welcome tape lets you set up the volume control so you have no trouble reading off tape. I use a very expensive cassette recorder which has manual level control for recording and the facility to adjust the speed, but we have tested the BBC system with every cassette in the office and it never failed to load or save.

Actually, for most systems, you often find that the cheaper the recorder, the better the results!

The reason for this apparent anomoly is that more expensive recorders are designed to ignore such nasty things as DC levels — your computer tends to send its tones as square waves rather than nice sine waves, so the expensive cassette recorder just ignores them.

The second enquiry concerning the BBC Micro comes from Mr Beck of Plymouth who is concerned about the choice of printer.

I hope that this enquiry does not cause too many problems, but what printer should I buy for my BBC Model B computer? Among those I've considered are the MX series and the Seikosha.

Take heart, Mr Beck. The indications are that there will be a special version of the MX series launched which will allow full screen dumping of the graphics and I expect that by the time this issue goes on sale, the announcement will have been made. I wouldn't choose the Seikosha — because of the restricted paper width — you simply won't be able to get the highest resolution to print decently. There is absolutely nothing wrong with the printer itself though, if you just want it for producing listings.

You also mentioned in your letter that the choice of parallel or serial connection seemed to be a problem area. Bad news I'm afraid, the serial output port is not the old 25-way D type but a DIN socket instead, so you'll still have to do some soldering. I would prefer to use the parallel port myself and leave the serial one free for other things such as a modem. This does restrict the length of cable to about 2 m for practice use, but this shouldn't be too awkward.

More To Come

That's about all I have room for this month except to ask that even more of you send in your letters so that we have a wide and varied selection to choose from.

One small point, however. Please don't send in queries that you want a personal reply to as these should be accompanied by an SAE and sent to Technical Enquiries (Computing Today) at our usual address. This latter service deals with problems concerning topics within the magazine as opposed to the more general advice offered here.

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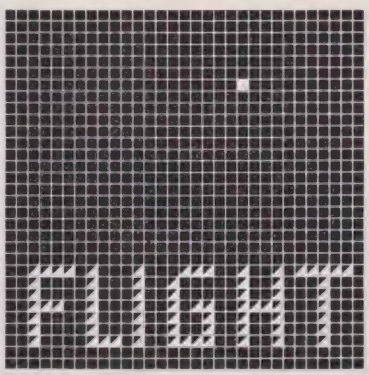

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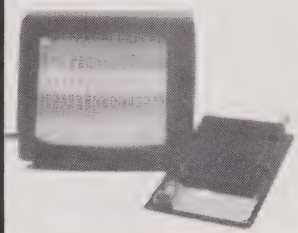

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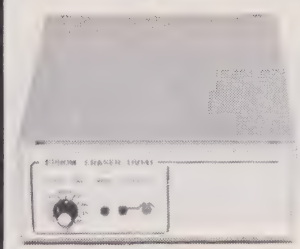

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S M Gee

BOOK PAGE

Our monthly look at the world of computer publications turns its attentions to yet more volumes aimed at helping you to an understanding of the subject.

There are currently lots of books available which serve as introductions to the personal computer. In December's CT, for example, I looked at Buchbaum's 'The Personal Computer Handbook' and Jarrett's 'The Good Computing Book for Beginners'; two books with very different approaches. This month I'm going to consider two more.

The Second Edition of **Your Own Computer** by Mitchell Waite and Michael Pardee came out in October last year. It takes a very conventional approach to the business of imparting basic information about personal computers. Chapter one traces the history of microcomputers. This may sound very pedestrian but in fact it is very well written and gives much more 'inside information' than many others. In the section 'Where are we now?', the authors divide the available personal and small business computers into three categories: the pocket (or hand-held) computer; the desktop computer, which may or may not have all components integrated into one package; and the mainframe computer under which heading are included 'larger computers with frames for holding the various circuit boards that make up the computer system' — the term no longer needs summon up images of vast rooms filled with hardware.

The front cover poses the question 'What's coming in 1990'. Admittedly this is in small print but even so I was disappointed to find only four pages devoted to crystal ball gazing. As for the predictions, the authors present an interesting discussion of what people want from their computers but does not go into what it might be possible to achieve by the end of another decade.

Chapter two is a straightforward glossary, chapter three deals with applications in a way that is more imaginative than many comparable books. Chapter four looks at programming from the user's point of view. Chapter five is an examination of the 'Nuts and Bolts of a Computer', covering the CPU and binary arithmetic (also covered in the appendix on numbering systems), memory, input/output devices and interfaces, and software. This is standard material but it is very well presented with helpful photographs and diagrams. Chapter six is the up-to-date core of the book and compares 30 computers. From the British reader's point of view this suffers from having been prepared on the wrong side of the Atlantic. Although it would be possible to obtain all but one of the machines mentioned in the UK, a fifth of them are not well known over here and there are some notable omissions (the ZX81, the Acorn ATOM, the DAI and the BBC micro). The final chapter, 'Getting Started' also suffers in the same way. It gives very good advice but when it offers specific information, this is not relevant to the UK.

I liked this book a lot, even though it is similar to many others. Its main drawback (which it shares with so many of the alternatives) is that it was written primarily for a US audience.

Zaks' new book **Don't (Or How To Care for Your Computer)** is a book to frighten the personal computer owner. The preface is reasonably reassuring; Zaks tells us: "provided you follow the simple rules presented in this book you should enjoy years of trouble-free operation". The rules however are almost impossible unless you happen to live in an operating theatre as the hazards to avoid include dust, cups of tea or coffee, cigarette smoke and even static from pile carpets. Heat and cold are also potential enemies of your computer but by far the worst, it seems, are human beings.

Zaks' book can at least help overcome the problems of human error caused by carelessness and ignorance. Chapters are included on the proper way to use floppy discs, hard discs, the computer itself, CRT terminals, printers and tape units. At the beginning of each chapter there is a summary of advice for the home computer user. This is very useful but almost invariably includes a near-impossibility, commonly 'avoid dust'! Apart from that on tape units, each chapter presents 'a typical horror story' describing the terrible consequences of ordinary, everyday mishaps. A chapter is devoted to the computer room. As far as the home computer user is concerned, Zaks' main recommendation is "Keep the room comfortable for a human. Your computer will like it too." In other words, 'clean power' (ie no voltage fluctuations — can be tricky), 'no static' (translates as no carpets, especially any containing man-made fibres) and 'no dust' (ie you need an air filter). The final chapters cover software, documentation and security (which fortunately will not concern most home users) and what to do when your system does not work. This last chapter does not have a lot to offer by way of useful advice. It suggests that when the system fails 'suspect the human operator first' — this is cold comfort if you are the human who has just blown your own system.

Don't is salutory reading — don't read it at bedtime, it will give you a sleepless night. But take heart; if after reading Zaks' book you come to the conclusion that computers cannot possibly work in a normal environment, they do and will continue to do so.

The books included in this month's selection were:

Your Own Computer by Mitchell Waite and Michael Pardee, distributed by Prentice Hall, published by Sams (1981), 222 pages, £5.55.

Don't (Or How To Care For Your Computer) by Rodnay Zaks, distributed by Computer Bookshop, published by Sybex, (1981), 218 pages, £9.65.

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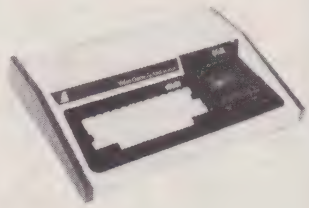

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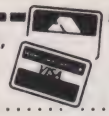

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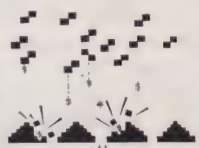

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J D Lee and T D Lee

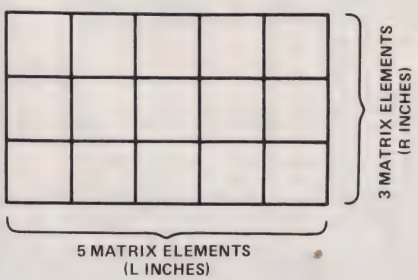
Print giant characters with this utility. The routines to actually generate the correct shapes are also of use on their own for producing other shapes.

A program is described here which will print a message in the form of a poster on a teleprinter type roll of paper. The size of the characters may be selected by the user and considerable care has been taken to produce well formed and easy to read characters. The program is written in Microsoft BASIC-80, but special features have been avoided as far as possible to enable its easy implementation using other versions of BASIC. The program occupies 14K of disc space when saved in ASCII form under CP/M, but this can be greatly reduced by removing REM statements, omiting the word LET and reducing the number of spaces. It is interesting to note that the same program stored under North Star BASIC occupies only 10½K!

Character Generation

Most characters may be formed from a 5 x 3 rectangular matrix. At first sight this is a very small matrix, since video displays and dot matrix printers commonly use a matrix of 7 x 5; often 9 x 7 and sometimes an even larger matrix. The program achieves good character resolution because it has the option of partially filling a matrix element whereas a video display or printer must either totally fill or leave a matrix element completely blank since a dot must be either present or absent.

The program assumes that the printer types 10 characters per inch horizontally and six lines per inch vertically. To obtain a character L inches high and R inches wide, each element in the matrix will contain 2L by 2R printed characters.

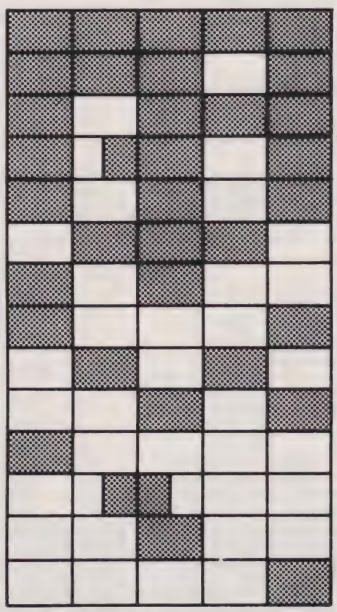


Using these elements, a large number of characters can be printed. For example the letter H

In a similar way the letters A, C, E, F, I, J, L, O, P, T and U can be printed. Note that many characters use the same matrix elements in a row, for example row 1 of H is the same as row 3 of H, and row 2 of T etc. Rather than write the same lines of code in many places, a set of 14 subroutines have been produced to print various combinations of matrix elements, see Fig. 1.

The Rectangular Routines

Many characters can be printed by using just three subroutine calls. For example, H is printed by going to subroutines 3730,4330 and 3730 in turn and T is printed by the subroutines 4380,3730 and 4380.



LINES	USED BY LETTERS
3730–3760	A B D E F H I J K L M N P R T U 1 9 # []
3780–3810	G
3830–3860	5 !
3880–3910	?
3930–3960	B E G S 2 3 5 6 8
3980–4010	+
4030–4060	:
4080–4110	C D E G O Q 3 () []
4130–4160	# =
4180–4210	A F P 9 ?
4230–4260	J L U .
4280–4310	4
4330–4360	G H + –
4380–4410	F T '

Fig. 1. The 14 rectangular subroutines together with the letters they are used for.

While a great deal can be accomplished using these 14 rectangular subroutines, the exclusive use of rectangular characters causes ambiguity between certain pairs of characters such as D and 0, B and 8 or S and 5. To improve the look of characters and to provide better discrimination between ambiguous pairs, some characters are tapered (rounded). One subroutine tapers the left-hand side of a character and a second subroutine tapers the right-hand side.

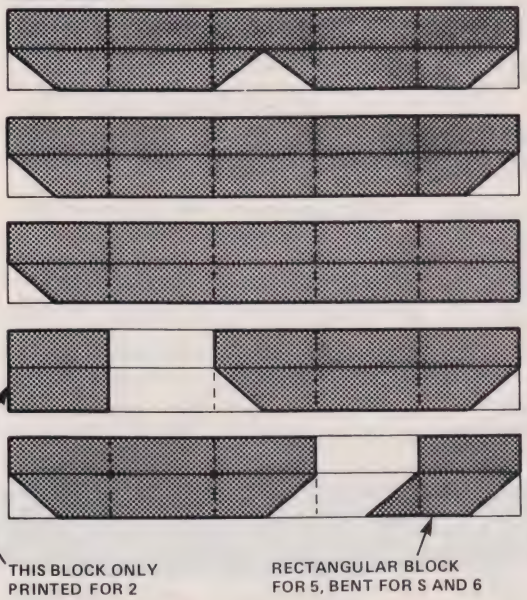
The Tapering Subroutines

The two tapering subroutines are considerably more complex than the rectangular subroutines, and they have four input parameters B1, B2, B3 and B4. By varying the values of these four parameters a wide range of different tapers can be produced. The right-hand tapering subroutine (lines 4430-4800) is shown in Fig. 2.

The parameters B1, B2, B3 and B4 are used in a smilar way in both tapering subroutines, and their functions are:

B1 This is the number of humps which, by default, is set to 1 but has

Fig.2. Tapering routines for the right-hand side...



USED FOR CHARACTERS	PARAMETERS B1	B2	B3	B4
B,3,8	2	0	0	2
D,O,Q,)	1	0	5L	2
J,U	1	0	5L	1
P,2,?	1	4L	L	2
S,5,6	1	0	L	2
DEFAULT VALUES	1	0	0	2

```
THESE ARE THE CHARACTERS THAT I CAN PRINT:
ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789.:!?'@+-=/\()[]

TYPE HEIGHT AND WIDTH OF CHARACTERS IN INCHES
? 4,3

HOW MANY INCHES GAP DO YOU WANT AT THE LEFT HAND SIDE
? 1

TYPE THE MESSAGE FOR THE POSTER
? POSTER
```

a value of 2 for the double hump in B, 3 and 8.

B2 This defines how far to indent the hump, and is zero by default but has the value of 4L for P, 2 and ?.

B3 This specifies the size of the hump (s). The actual size of a hump is 5L + B3.

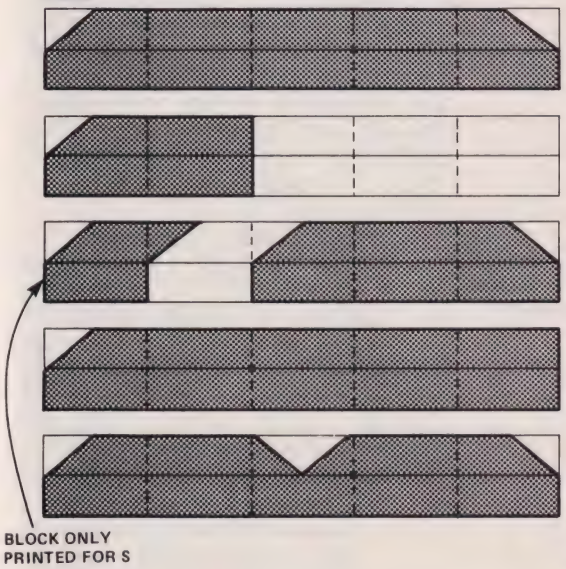
B4 This indicates whether a one-tailed or a two-tailed hump is required.

By default a two-tailed hump is drawn (B4 = 2), but for J and U a one-tailed hump is required (B4 = 1).

Because of the default values, only the parameters which are underlined need setting before the tapering subroutines are called.

The left-hand tapering subroutines (lines 4820-5050) are shown in Fig. 3.

Fig. 3. ...and those for the left-hand side.



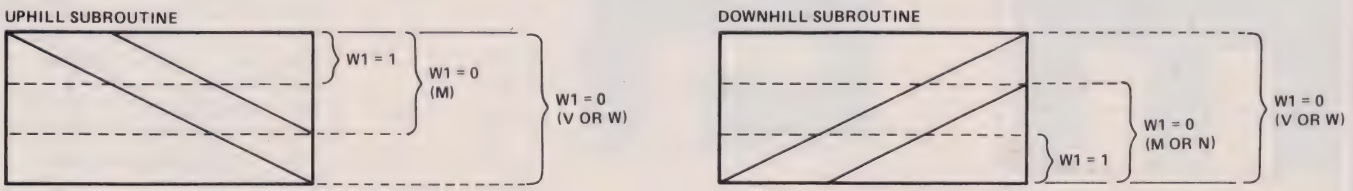
USED FOR CHARACTERS	PARAMETERS B1	B2	B3	B4
C,G,O,Q,6,(	1	0	0	2
J	1	0	−6L	1
S,9	1	4L	−4L	2
U	1	0	0	1
8	2	0	−5L	2
DEFAULT VALUES	1	0	0	2

The parameters B1, B2 and B4 are exactly the same as for the right-hand subroutine. However, B3 is different — it still defines the hump size, but hump size = 10L + B3 in the left-hand subroutine.

Diagonal Subroutines

The sixteen subroutines described so far do not allow for the printing of diagonal lines, which are needed for the letters K, M, N, V, W, X, Y and Z. A subroutine at lines

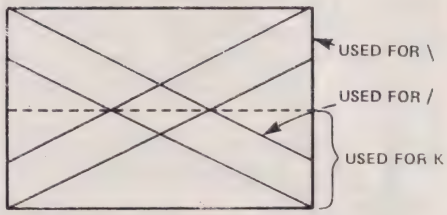
Fig. 4. The 'uphill' and 'downhill' diagonals produced by the two subroutines at 5070 and 5300.



5070-5280 prints an 'uphill' diagonal, and a subroutine at lines 5300-5490 prints a 'downhill' diagonal. These two subroutines have a single parameter W1 which specifies whether the whole of the diagonal or only half of the diagonal is printed, see Fig. 4.

Use of these two subroutines allows the letters M, N, V and W to be printed, but does not allow the printing of K, X, Y or Z.

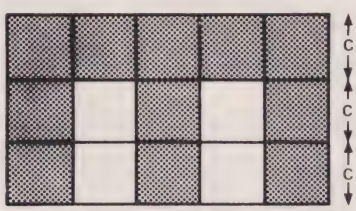
A separate section of code (lines 2390-2540) is used to produce the letter X, and the same code is used to produce the second half of the letter K as well as / and \.

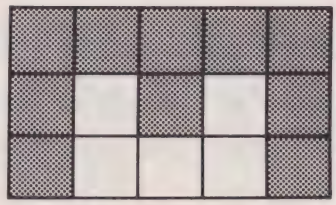


The remaining characters which involve diagonals are the letters Y and Z and the digit 7. Special routines have been written for these characters. The two remaining letters are C and R. The latter cannot be produced from the existing subroutines satisfactorily, and hence has been coded separately (lines 2000-2200). Whilst most of letter C can be produced by the subroutines, an extra three lines of code (lines 1100-1120) have been added to curve the right-hand edge of the letter. The remaining digits 2 and 4 each have special routines (lines 3010-3080 print the left part of digit 2 and lines 3200-3300 print the left part of digit 4).

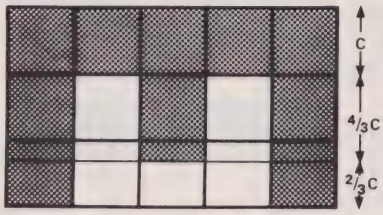
Improving Character Shape

All of the capital letters can now be produced, but some can be improved by simple alterations to the program. Consider the letter E.





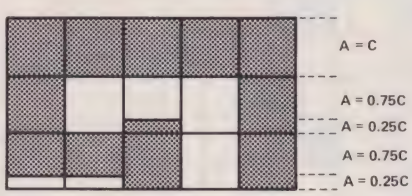
Either of the above could be used, but changing the lengths of the horizontal limbs improves the appearance.



This is achieved by letting the 14 rectangular subroutines print a variable number of lines of output rather than always printing the same number of lines C. (Note that C depends on the width of the characters in inches and C = 2R.) Before each rectangular subroutine is called, the variable A is set to the number of lines of output required. Thus to print E in the final improved form:

set A = C and call
subroutine 3730
then
set A = ⅘C and call
subroutine 3930
and finally
set A = ⅔C and call
subroutine 4080.

The letter F can be improved in an analogous manner. An extension of this technique is used to improve the letter G as shown below:



A consequence of this improvement is that the characters need not be three elements wide, and some characters may be printed wider than others. Thus when the 'width' of characters is specified at the beginning of a run, this is an average width and some characters will be printed wider and others narrower.

Characters Which May Be Printed

The program will print 52 characters. These are:

the capital letters A to Z
the digits 0 to 9
and space . : ! ? ' # + − =
/ \ () [ ]

The lower case letters are not implemented because g j p q and y have descenders (go below the line), and the same applies to commas and semicolons. Double quotation marks are not implemented because they would interfere with string handling in BASIC. A challenge for enthusiasts is to implement * and £.

Character Handling

The program makes extensive use of strings and follows the conventions used in Microsoft BASIC, namely that character strings are not declared in DIMension statements and sub-strings are obtained using LEFT$, RIGHT$ and MID$. Some versions of BASIC require that character strings be DIMensioned, and when using such a BASIC an extra line must be added to the program:

```
15 DIM C$(52), B$(80), D$(1),
   G$(8), M$(16), L$(40), K$(80)
```

Such versions of BASIC require a change to the sub-stringing in lines 280 and 420, and for example MID$ (C$, A(K), 1) should be replaced by C$(A(K), A(K)) in line 420, and similar changes made to line 280.

C$	This contains a list of all the characters that the program can print. If new characters are implemented, they must be added to the string in line 40.
B$	This is used to store the message which will be printed as the poster.
D$	This is a string containing just one character — the one currently being printed.
G$	This is used to store the current character L times
M$	This is used to store the current character 2L times
L$	This is used to store the current character 5L times

	(where L is the height of the characters in inches).
K$	This is used to print the letter X.
L	Stores the height (in inches) of the characters to be printed.
R	Stores the width (in inches) of the characters to be printed.
C(=2R)	This is the number of printer lines per matrix element.
S	This is the number of inches gap at the left side of the poster multiplied by 10.
A	The number of lines to print in a rectangular subroutine. This is used in improving the shapes of characters.
K	This denotes which character in the message to be printed is currently being printed, eg when K = 3 the third character is being printed.
A(n)	The A array is used to determine which character to print from the characters stored in C$. For example, if the message to be printed is BAD this will be stored in B$. The characters which may be printed are stored in C$, and begin A B C D . . . A(1) = 2 since the second character of C$ is B A(2) = 1 since the first character of C$ is A A(3) = 4 since the fourth character of C$ is D Thus the array A( ) is a numerical representation of the message in B$.
B1, B2, B3, B4	These are parameters for the tapering subroutines.
W1	This is the parameter used for the diagonal subroutines.

Table 1. Major variables and their functions within the program.

Running The Program

The program prints a heading and then types a list of the characters which may be used. The program then requests the height and width in inches of characters to be printed. The user types these two numbers separated by a comma, and then presses RETURN. It is recommended that the values chosen are multiples of half an inch, and that the height is slightly more than the width. The height is checked to ensure that it is less than or equal to eight inches — the width of a normal teleprinter roll. The program then requests the gap to be left at the left hand side (in inches). A further check is made to ensure that the size of characters plus gap will fit on the paper. Finally the user is asked to type in the message to be printed. The program checks that all of the characters can be recognised by the program before starting to print the poster.

Modifications

To get the program running under North Star BASIC, strings must be DIMensioned and the substring functions altered as previously mentioned. In addition, the word THEN in line 280 must be changed to THEN EXIT and the GOTO in line 320 must be replaced by EXIT.

For users of XITAN disc BASIC, as used on the RML 380Z, a CLEAR statement must be added. Typically this would be 5 CLEAR 1000.

Program Listing

```
10 DIM A(80)
20 PRINT TAB(20); "POSTER"
30 PRINT TAB(20); "======"
40 LET C$ ="ABCDEFGHIJKLMNOPQRSTJVWXYZ 0123456789.:!?'$+-=/\()[]"
50 PRINT
60 PRINT "THESE ARE THE CHARACTERS THAT I CAN PRINT:"
70 PRINT C$
80 PRINT
90 PRINT "TYPE HEIGHT AND WIDTH OF CHARACTERS IN INCHES"
100 INPUT L, R
110 IF L <= 8 THEN 140
120 PRINT "CHOOSE SMALLER LETTERS"
130 GOTO 90
140 LET C = R * 2
150 PRINT
160 PRINT "HOW MANY INCHES GAP DO YOU WANT AT THE LEFT HAND SIDE"
170 INPUT S
180 IF S + L <= 8 THEN 220
190 PRINT "CHOOSE A SMALLER GAP OR SMALLER CHARACTERS"
200 PRINT "GAP + CHARACTER HEIGHT MUST BE LESS THAN 8 INCHES"
210 GOTO 80
220 LET S = 10 * S
230 PRINT
240 PRINT "TYPE THE MESSAGE FOR THE POSTER"
250 INPUT B$
260 FOR V = 1 TO LEN(B$)
270 FOR L1 = 1 TO LEN(C$)
280 IF MID$(B$, V, 1) = MID$(C$, L1, 1) THEN 330
290 NEXT L1
300 PRINT TAB(V), "^"
310 PRINT "CHARACTER NOT RECOGNISED"
320 GOTO 250
330 LET A(V) = L1
340 NEXT V
350 LET K = 0
360 LET W1 = 0
370 LET A = 4 * C
380 GOSUB 5510
390 IF K = LEN(B$) THEN 5550
400 LET K = K + 1
410 GOSUB 4760
420 D$ = MID$(C$, A(K), 1)
430 LET G$ = ""
440 FOR X = 1 TO L
450 LET G$ = G$ + D$
460 NEXT X
470 LET A = C * .5 + 1
480 GOSUB 5510
490 LET A = C
500 LET M$ = G$ + G$
510 LET L$ = M$ + M$ + G$
520 IF A(K) > 45 THEN 680
530 IF A(K) > 36 THEN 660
540 IF A(K) > 27 THEN 640
550 IF A(K) > 18 THEN 620
560 IF A(K) > 9 THEN 600
570 REM ****    A,    B,    C,    D,    E,    F,    G,    H,    I
580 ON A(K) GOTO 990, 1020, 1050, 1150, 1270, 1340, 1400, 1500, 1530
590 REM ****    J,    K,    L,    M,    N,    O,    P,    Q,    R
600 ON A(K) - 9 GOTO 1560, 1630, 1690, 1750, 1750, 1810,
    1840, 1880, 1970
610 REM ****          S,    T,    U,    V,    W,    X,    Y,
    Z,  SPACE
620 ON A(K) - 18 GOTO 3420, 2230, 1570, 2290, 2340, 2390, 2570,
    2830, 2970
630 REM ****          0,    1,    2,    3,    4,    5,
    6,    7,    8
640 ON A(K) - 27 GOTO 1810, 1530, 3010, 3140, 3200, 3360,
    3450, 3480, 3620
650 REM ****          9,    .,    :,    !,    ?,    ',    #,    +,    -
660 ON A(K) - 36 GOTO 3670, 1720, 880, 700, 730, 2260, 910, 770, 810
670 REM ****          =,    /,    \,    (,    ),    [,    ]
680 ON A(K) - 45 GOTO 850, 2390, 2390, 1050, 1170, 1150, 1240
690 REM *** PRINT !
700 GOSUB 3830
710 GOTO 390
720 REM *** PRINT ?
730 GOSUB 3880
740 LET A = C * .5
750 GOTO 1850
760 REM *** PRINT +
770 GOSUB 4330
780 GOSUB 3980
790 GOTO 820
800 REM *** PRINT -
810 LET A = C * 2
820 GOSUB 4330
830 GOTO 390
840 REM *** PRINT =
850 LET A = 2 * C
860 GOTO 960
870 REM *** PRINT :
880 GOSUB 4030
890 GOTO 390
900 REM *** PRINT #
910 LET A = C * 2 / 3
920 GOSUB 4130
930 GOSUB 3730
940 GOSUB 4130
950 GOSUB 3730
960 GOSUB 4130
970 GOTO 390
980 REM *** PRINT A
990 GOSUB 3730
1000 GOTO 3700
1010 REM *** PRINT B
1020 GOSUB 3730
1030 GOTO 3170
1040 REM *** PRINT C, (
1050 GOSUB 4820
1060 LET A = C * .75
1070 GOSUB 4080
1080 IF D$ = "(" THEN 390
1090 GOSUB 4080
1100 FOR X = 1 TO C / 2
1110 PRINT TAB(S + X); M$; TAB(S + 8 * L - X); M$
1120 NEXT X
```

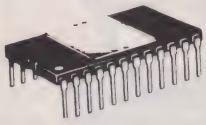
```
1130 GOTO 390
1140 REM *** PRINT D, [
1150 GOSUB 3730
1160 GOTO 1190
1170 REM ***PRINT )
1180 LET A = C * .75
1190 GOSUB 4080
1200 IF D$ = "[" THEN 390
1210 LET B3 = 5 * L
1220 GOTO 3390
1230 REM *** PRINT ]
1240 GOSUB 4080
1250 GOTO 1530
1260 REM ***PRINT E
1270 GOSUB 3730
1280 LET A = C * 4 / 3
1290 GOSUB 3930
1300 LET A = C - INT(C / 3)
1310 GOSUB 4080
1320 GOTO 390
1330 REM ***PRINT F
1340 GOSUB 3730
1350 LET A = C * 4 / 3
1360 GOSUB 4180
1370 LET A = C - INT(C / 3)
1380 GOTO 2260
1390 REM ***PRINT G
1400 GOSUB 4820
1410 LET A = .75 * C
1420 GOSUB 4080
1430 LET A = C - INT(.75 * C)
1440 GOSUB 3930
1450 LET A = C * .75
1460 GOSUB 3780
1470 LET A = C - INT (.75 * C)
1480 GOTO 820
1490 REM ***PRINT H
1500 GOSUB 3730
1510 GOSUB 4330
1520 REM *** PRINT I, 1
1530 GOSUB 3730
1540 GOTO 390
1550 REM *** PRINT J, U
1560 LET B3 = -6 * L
1570 LET B4 = 1
1580 GOSUB 4820
1590 GOSUB 4230
1600 LET B4 = 1
1610 GOTO 1210
1620 REM ***PRINT K
1630 GOSUB 3730
1640 LET X1 = 3.5 * L + .5
1650 LET X2 = 10 * L
1660 LET X3= (X2 - X1) / (2 * C - 1)
1670 GOTO 2420
1680 REM ***PRINT L
1690 GOSUB 3730
1700 LET A = 2 * C
1710 REM ***PRINT .
1720 GOSUB 4230
1730 GOTO 390
1740 REM ***PRINT M
1750 GOSUB 3730
1760 GOSUB 5300
1770 IF D$ = "N" THEN 1530
1780 GOSUB 5070
1790 GOTO 1530
1800 REM *** PRINT O, 0
1810 GOSUB 4820
1820 GOTO 1190
1830 REM ***PRINT P
1840 GOSUB 3730
1850 GOSUB 4180
1860 GOTO 3100
1870 REM ***PRINT Q
1880 GOSUB 4820
1890 LET A = C - 1
1900 GOSUB 4080
1910 PRINT TAB(S); M$; TAB(S + 3 * L); M$; TAB(S + 8 * L); M$
1920 LET B3 = 5 * L
1930 GOSUB 4430
1940 PRINT TAB(S + L); M$
1950 GOTO 390
1960 REM ***PRINT R
1970 GOSUB 3730
1980 LET A = C * .25
1990 GOSUB 4180
2000 LET J = 0
2010 FOR X = 4 * L - 1 TO -4 * L + 1 STEP (-8 * L + 2)
     / INT(7 * C / 4 - 1)
2020 IF X > 0 THEN 2050
2030 PRINT TAB(S);
2040 GOTO 2060
2050 PRINT TAB(S + INT(X));
2060 LET K2 = 4 * L -INT(ABS(X))
2070 GOSUB 5460
2080 PRINT TAB(S + 4 * L);
2090 IF X >= (4 * L - 1) / 7 THEN 2180
2100 IF X >= (3 - 12 * L) / 7 THEN 2160
2110 LET J = J + 1
2120 PRINT TAB(4 * L + S + J);
2130 LET K2 = 6 * L - 2 * J
2140 GOSUB 5460
2150 GOTO 2190
2160 PRINT L$; G$;
2170 GOTO 2190
2180 PRINT M$; TAB(S + 8 * L); M$;
2190 PRINT
2200 NEXT X
2210 GOTO 390
2220 REM ***PRINT T
2230 GOSUB 4380
2240 GOSUB 3730
2250 REM ***PRINT '
2260 GOSUB 4380
2270 GOTO 390
2280 REM ***PRINT V
2290 GOSUB 5300
2300 LET W1 = 0
2310 GOSUB 5070
2320 GOTO 390
2330 REM ***PRINT W
2340 GOSUB 5300
2350 LET W1 = 1
2360 GOSUB 5070
2370 GOTO 2290
2380 REM *** PRINT X, /, \
2390 LET X1 = 1 - 3 * L
2400 LET X2 = 10 * L
2410 LET X3 = (X2 - X1) / (4 * C - 1)
2420 FOR X = X1 TO X2 STEP X3
2430 LET K$ = ""
2440 FOR Y = 1 TO 10 * L
2450 IF D$ = "\" THEN 2470
2460 IF (Y - X) * (Y - X - 3 * L) <= 0 THEN 2510
2470 IF D$ = "/" THEN 2490
2480 IF (Y - 10 * L + X - 1) * (Y - 7 * L + X - 1) <= 0 THEN 2510
2490 LET K$ = K$ + " "
2500 GOTO 2520
2510 LET K$ = K$ + D$
2520 NEXT Y
2530 PRINT TAB(S); K$
2540 NEXT X
2550 GOTO 390
2560 REM ***PRINT Y
2570 FOR X = 10 * L - 1 TO 3 * L STEP (1 - 7 * L) / (1.5 * A - 1)
2580 IF X >= (16 * L - 1) / 3 THEN 2620
2590 PRINT TAB(S);
2600 LET K2 =4 * L + INT(X)
2610 GOTO 2660
2620 PRINT TAB(S + INT(X));
2630 LET K2 = 4 * L
2640 IF 4 * L < 10 * L - INT(X) THEN 2660
2650 LET K2 = 10 * L - INT(X)
2660 GOSUB 5460
2670 PRINT
2680 NEXT X
2690 FOR X = 3 * L TO 10 * L - 1 STEP (7 * L - 1) / (1.5 * A - 1)
2700 IF X > (16 * L - 1) / 3 THEN 2740
2710 PRINT TAB(S);
2720 LET K2 = X + 4 * L
2730 GOTO 2780
2740 PRINT TAB(S + X);
2750 LET K2 = 4 * L
2760 IF 4 * L < 10 * L - INT(X) THEN 2780
2770 LET K2 = 10 * L - INT(X)
2780 GOSUB 5460
2790 PRINT
2800 NEXT X
2810 GOTO 390
2820 REM ***PRINT Z
2830 FOR X = 0 TO L * 7 STEP L * 7 / (C * 3)
2840 PRINT TAB(S); M$;
2850 IF X <= 2 * L THEN 2870
2860 PRINT TAB(S + INT(X));
2870 LET K2 = 3 * L
2880 IF K2 <= L + INT(X) THEN 2900
2890 LET K2 = L + INT(X)
2900 IF K2 <= 8 * L - INT(X) THEN 2920
2910 LET K2 = 8 * L - INT(X)
2920 GOSUB 5460
2930 PRINT TAB(S + 8 * L); M$
2940 NEXT X
2950 GOTO 390
2960 REM *** PRINT SPACE
2970 LET A = C * 3
2980 GOSUB 5510
2990 GOTO 390
3000 REM *** PRINT 2
3010 FOR X = C / 2 TO -C / 2 + 1 STEP -1
3020 PRINT TAB(S);
3030 LET K2 = 6 * L - INT(X)
3040 IF INT(X) > 0 THEN 3060
3050 LET K2 = 6 * L
3060 GOSUB 5460
3070 PRINT TAB(S + K2 + 2 * L); M$
3080 NEXT X
3090 GOSUB 3930
3100 LET B2 = 4 * L
3110 LET B3 = L
3120 GOTO 3390
3130 REM *** PRINT 3
3140 LET A = C - INT(C / 3)
3150 GOSUB 4080
3160 LET A = C * 4 / 3
3170 LET B1 = 2
3180 GOTO 3380
3190 REM *** PRINT 4
3200 FOR X = -L TO L * 4 STEP L * 5 / INT(7 * A / 4)
3210 PRINT TAB(S + 3 * L); M$;
3220 IF X < 2 * L THEN 3240
3230 PRINT TAB(S + X + 3 * L);
3240 IF X < 2 * L THEN 3270
3250 PRINT M$; G$
3260 GOTO 3300
3270 LET K2 = X + L
3280 GOSUB 5460
3290 PRINT
3300 NEXT X
3310 GOSUB 3730
3320 LET A = C * .5
3330 GOSUB 4280
3340 GOTO 390
3350 REM *** PRINT 5
3360 GOSUB 3830
```

```
3370 LET B3 = L
3380 GOSUB 3930
3390 GOSUB 4430
3400 GOTO 390
3410 REM *** PRINT S
3420 LET B2 = 4 * L
3430 LET B3 = -B2
3440 REM *** PRINT 6
3450 GOSUB 4820
3460 GOTO 3370
3470 REM *** PRINT 7
3480 FOR X = -3 * L + 1 TO 8 * L STEP (11 * L - 1) / (3 * A)
3490 LET K2 = 3 * L
3500 IF X <= 0 THEN 3530
3510 PRINT TAB(S + INT(X));
3520 GOTO 3550
3530 PRINT TAB(S);
3540 LET K2 = X + 3 * L
3550 IF INT(X) <= 5 * L THEN 3570
3560 LET K2 = 8 * L - INT(X)
3570 GOSUB 5460
3580 PRINT TAB(S + 8 * L); M$
3590 NEXT X
3600 GOTO 390
3610 REM *** PRINT 8
3620 LET B3 = -5 * L
3630 LET B1 = 2
3640 GOSUB 4820
3650 GOTO 3170
3660 REM *** PRINT 9
3670 LET B2 = 4 * L
3680 LET B3 = -B2
3690 GOSUB 4820
3700 GOSUB 4180
3710 GOTO 1530
3720 REM *** SUBROUTINE TO PRINT !**!**!**!**!**!
3730 FOR X = 1 TO A
3740 PRINT TAB(S); L$; L$
3750 NEXT X
3760 RETURN
3770 REM *** SUBROUTINE TO PRINT !**!**!**!  !**!
3780 FOR X = 1 TO A
3790 PRINT TAB(S); L$; G$; TAB(S + 8 * L); M$
3800 NEXT X
3810 RETURN
3820 REM *** SUBROUTINE TO PRINT !**!  !**!**!**!
3830 FOR X = 1 TO A
3840 PRINT TAB(S); M$; TAB(S + 4 * L); L$; G$
3850 NEXT X
3860 RETURN
3870 REM *** SUBROUTINE TO PRINT !**! *!**!  !**!
3880 FOR X = 1 TO A
3890 PRINT TAB(S); M$; TAB(S + 3 * L); M$; G$; TAB(S + 8 * L); M$
3900 NEXT X
3910 RETURN
3920 REM *** SUBROUTINE TO PRINT !**!  !**!  !**!
3930 FOR X = 1 TO A
3940 PRINT TAB(S); M$; TAB(S + 4 * L); M$; TAB(S + 8 * L); M$
3950 NEXT X
3960 RETURN
3970 REM *** SUBROUTINE TO PRINT !  !**!**!**!  !
3980 FOR X = 1 TO A
3990 PRINT TAB(S + 2 * L); G$; L$
4000 NEXT X
4010 RETURN
4020 REM *** SUBROUTINE TO PRINT !**!  !**!  !  !
4030 FOR X = 1 TO A
4040 PRINT TAB(S); M$; TAB(S + 4 * L); M$
4050 NEXT X
4060 RETURN
4070 REM *** SUBROUTINE TO PRINT !**!  !  !  !**!
4080 FOR X = 1 TO A
4090 PRINT TAB(S); M$; TAB(S + 8 * L); M$
4100 NEXT X
4110 RETURN
4120 REM *** SUBROUTINE TO PRINT !  !**!  !**!  !
4130 FOR X = 1 TO A
4140 PRINT TAB(S + 2 * L); M$; TAB(S + 6 * L); M$
4150 NEXT X
4160 RETURN
4170 REM *** SUBROUTINE TO PRINT !  !  !**!  !**!
4180 FOR X = 1 TO A
4190 PRINT TAB(S + L * 4); M$; TAB(S + L * 8); M$
4200 NEXT X
4210 RETURN
4220 REM *** SUBROUTINE TO PRINT !**!  !  !  !  !
4230 FOR X = 1 TO A
4240 PRINT TAB(S); M$
4250 NEXT X
4260 RETURN
4270 REM *** SUBROUTINE TO PRINT !  ! *!* !  !  !
4280 FOR X = 1 TO A
4290 PRINT TAB(S + 3 * L); M$
4300 NEXT X
4310 RETURN
4320 REM *** SUBROUTINE TO PRINT !  !  !**!  !  !
4330 FOR X = 1 TO A
4340 PRINT TAB(S + 4 * L); M$
4350 NEXT X
4360 RETURN
4370 REM *** SUBROUTINE TO PRINT !  !  !  !  !**!
4380 FOR X = 1 TO A
4390 PRINT TAB(S + 8 * L); M$
4400 NEXT X
4410 RETURN
4420 REM *** SUBROUTINE FOR RIGHT-HAND TAPERING OF CHARACTERS
4430 FOR X = 1 TO C / 2
4440 IF D$ = "5" THEN 4560
4450 IF D$ = "6" THEN 4560
4460 IF D$ = "S" THEN 4560
4470 IF D$ = "2" THEN 4540
4480 IF D$ = "?" THEN 4520
4490 IF D$ = "P" THEN 4520
4500 PRINT TAB(S); L$; L$
4510 GOTO 4570
4520 PRINT TAB(S + 4 * L); L$; G$
4530 GOTO 4570
4540 PRINT TAB(S); M$; TAB(S + 4 * L); L$; G$
4550 GOTO 4570
4560 PRINT TAB(S); L$; G$; TAB(S + 8 * L); M$
4570 NEXT X
4580 FOR X = 1 TO C - INT(C / 2)
4590 IF D$ <> "2" THEN 4610
4600 PRINT TAB(S); M$;
4610 PRINT TAB(S + X + B2);
4620 LET K2 = L * 5 - B4 * X + B3
4630 GOSUB 5460
4640 IF B1 = 1 THEN 4670
4650 PRINT TAB(L * 5 + S + X);
4660 GOSUB 5460
4670 IF D$ = "5" THEN 4700
4680 IF D$ = "6" THEN 4700
4690 IF D$ <> "S" THEN 4740
4700 PRINT TAB(S + 8 * L - INT(X));
4710 IF D$ <> "5" THEN 4730
4720 PRINT TAB(S + 8 * L);
4730 PRINT M$;
4740 PRINT
4750 NEXT X
4760 LET B2 = 0
4770 LET B3 = 0
4780 LET B1 = 1
4790 LET B4 = 2
4800 RETURN
4810 REM *** SUBROUTINE FOR LEFT-HAND TAPERING OF CHARACTERS
4820 FOR X = C - INT(C / 2) TO 1 STEP -1
4830 IF D$ <> "S" THEN 4850
4840 PRINT TAB(S + X); M$;
4850 PRINT TAB(S + X + B2);
4860 LET K2 = 10 * L - B4 * X + B3
4870 GOSUB 5460
4880 IF B1 = 1 THEN 4910
4890 PRINT TAB(S + 5 * L + X);
4900 GOSUB 5460
4910 PRINT
4920 NEXT X
4930 FOR X = 1 TO C / 2
4940 IF D$ = "9" THEN 5030
4950 IF D$ = "S" THEN 5010
4960 IF D$ = "J" THEN 4990
4970 PRINT TAB(S); L$; L$
4980 GOTO 5040
4990 PRINT TAB(S); M$; M$
5000 GOTO 5040
5010 PRINT TAB(S); M$; TAB(S + 4 * L); L$; G$
5020 GOTO 5040
5030 PRINT TAB(S + 4 * L); L$; G$
5040 NEXT X
5050 GOTO 4760
5060 REM *** SUBROUTINE TO PRINT UPHILL DIAGONAL
5070 FOR X = 0 TO L * 10 STEP 10 * L / INT(C * 3 / 2)
5080 IF D$ <> "H" THEN 5110
5090 IF X > 6 * L THEN 5270
5100 IF X = 0 THEN 5270
5110 IF X <> 0 THEN 5140
5120 IF D$ = "W" THEN 5270
5130 IF D$ = "V" THEN 5270
5140 IF W1 <> 1 THEN 5160
5150 IF X > (5 * L - .5 - 10 * L / INT(1.5 * C)) THEN 5270
5160 IF INT(X) > 10 * L - 1 THEN 5190
5170 PRINT TAB(S + INT(X));
5180 GOTO 5200
5190 PRINT TAB(S + 10 * L - 1);
5200 LET K2 = 5 * L
5210 IF 5 * L < 10 * L - INT(X) THEN 5230
5220 LET K2 = 10 * L - INT(X)
5230 IF K2 >= 1 THEN 5250
5240 LET K2 = 1
5250 GOSUB 5460
5260 PRINT
5270 NEXT X
5280 RETURN
5290 REM *** SUBROUTINE TO PRINT DOWNHILL DIAGONAL
5300 FOR X = 10 * L - 1 TO 0 STEP (1 - 10 * L) / INT(1.5 * C)
5310 IF D$ = "H" THEN 5330
5320 IF D$ <> "N" THEN 5350
5330 IF X > 6 * L THEN 5430
5340 IF X = 0 THEN 5430
5350 IF W1 <> 1 THEN 5370
5360 IF X > 5 * L - 1 THEN 5430
5370 PRINT TAB(S + INT(X));
5380 LET K2 = 5 * L
5390 IF 5 * L < 10 * L - INT(X) THEN 5410
5400 LET K2 = 10 * L - INT(X)
5410 GOSUB 5460
5420 PRINT
5430 NEXT X
5440 RETURN
5450 REM *** SUBROUTINE TO PRINT CHARACTER D$ K2 TIMES
5460 FOR K3 = 1 TO K2
5470 PRINT D$;
5480 NEXT K3
5490 RETURN
5500 REM *** SUBROUTINE TO PRINT BLANK LINES
5510 FOR X = 1 TO A
5520 PRINT
5530 NEXT X
5540 RETURN
5550 LET A = 4 * C
5560 GOSUB 5510
5570 PRINT "FINISHED"
5580 END
```

The complete POSTERS program. The listing has been heavily commented to aid any conversion and can be packed into about 8K if all the REMs and LETs are ignored.

COMPUTER SYSTEMS

NEW LOW PRICES



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SOFTWARE

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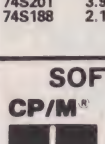

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LS09	23	LS174	72
LS10	15	LS175	60
LS11	15	LS181	155
LS12	16	LS190	85
LS13	30	LS191	85
LS14	40	LS192	75
LS15	20	LS193	75
LS20	15	LS194	99
LS21	15	LS195	99
LS22	18	LS196	99
LS26	18	LS202	345
LS27	22	LS221	75
LS28	30	LS240	95
LS30	17	LS241	99
LS32	15	LS242	99
LS33	16	LS243	99
LS37	16	LS244	80
LS38	16	LS245	110
LS40	20	LS247	75
LS42	40	LS248	75
LS47	50	LS249	75
LS48	80	LS251	75
LS49	99	LS253	75
LS51	15	LS257	75
LS54	20	LS258	75
LS55	30	LS259	160
LS63	150	LS261	250
LS73	25	LS266	25
LS74	23	LS273	90
LS75	28	LS275	320
LS76	20	LS279	88
LS78	45	LS280	250
LS83	75	LS283	75
LS85	105	LS290	99
LS86	29	LS293	99
LS90	35	LS295	170
LS91	80	LS298	215
LS93	35	LS299	420
LS95	99	LS324	200
LS96	110	LS325	320
LS107	45	LS326	330
LS109	30	LS327	315
LS112	50	LS352	130
LS113	50	LS353	130
LS114	35	LS356	55
LS122	60	LS366	40
LS123	50	LS367	40
LS124	120	LS368	65
LS125	30	LS373	90
LS126	50	LS374	99
LS132	45	LS375	50
LS133	30	LS377	90
LS136	30	LS378	70
LS138	35	LS379	65
LS139	37	LS386	30
LS145	90	LS390	75
LS148	95	LS393	75
LS151	75	LS395	199
LS153	40	LS396	199
LS155	50	LS398	275
LS156	50	LS399	199
LS157	35	LS445	140
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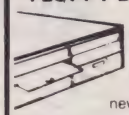

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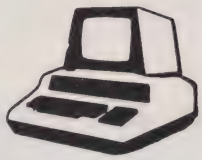

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1.008MHz	3.50	6.144MHz	2.70	18.432	2.90
1.8432MHz	3.00	7.0MHz	2.70	36MHz	2.90
2.00MHz	1.50	7.168MHz	2.50	48.0MHz	2.70
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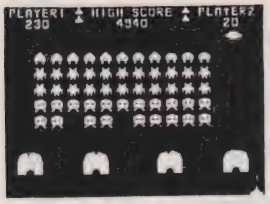

"The best excuse to expand your Atom. It is a superb version of the standard game, tough and fast" Your computer Nov '81 12K, graphics mode 4

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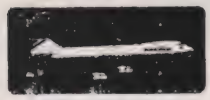
Fantastic machine code chess game for the 12K Atom. Features include: split screen (high res. + alphanumerics); many levels of play; castling & en passant; computer plays black or white. Supplied on cassette with instructions. *PRICE ONLY £9.00*

747



FLIGHT SIMULATION PROGRAM FOR THE 12K ATOM

Written for Bug-byte by a 747 pilot. Accurate simulation of a 747's cockpit display (airspeed, altitude, rate of climb, attitude, flaps, etc., and graphic display of horizontal situation and attitude); allows you to guide your craft to the landing strip. On making your final approach the display changes to a high-resolution 3D representation of the runway coming up to meet you. A real test of skill. Finding the runway is quite a challenge — landing safely is even more difficult. If you succeed, you are awarded a skill rating and the chance to take off and try again.

REQUIRES FLOATING POINT ROM **PRICE ONLY £8.00**

GALAXIAN

Fantastic high-resolution (mode 4) arcade game with fast-swooping aliens, excellent sound effects, and high score. 12K

PRICE £8.00

BACKGAMMON (7K, basic)

The program draws out a representation of a backgammon board and allows you to play the standard game against the computer. Playing instructions are not included, but if you can't already play the game, there are several books available to teach you, and the Atom makes an ideal, ever willing partner to build up your playing strength against.

Computer responses are rapid (approximately 10 seconds) and the program will not accept illegal moves. Dice throwing is controlled by the computer.

£7.00

LABYRINTH (12K, F.P., BASIC, GR.Mod2A, sound)

High-resolution colour graphics (also effective in Black & White) make this 3D maze program one of the best versions available. To help you find your way through the bewildering array of corridoors of the 30 x 15 cell random maze, you can call up to a 2D map of the maze. In the harder game option, this map shows only the portions of the maze which you have explored.

Your task is to find your way to the treasure room at the centre of the maze and then escape through the exit. To make things more difficult, several monsters (including the dreaded Minotaur) are loose in the maze, and you will have to fight your way past them. The types of monsters present, and their weapons can be altered by the user, if required.

REQUIRES THE FLOATING POINT ROM £7.00

LUNAR LANDER (12K, BASIC & s.c, Gr. Mod4)

A highly addictive arcade style program. A rugged lunar landscape is drawn out and you have to attempt to land your craft safely on the flat areas, by varying the thrust of your main & steering rockets. If you succeed, the ship takes off, and you have to try to land it again, under slightly more difficult conditions. This continues, until you have reduced 3 ships to heaps of rubble.

On screen readout of fuel and score. Several skill levels. A record is kept of the high score. If you are a sufficiently expert pilot, you will be rewarded with extra ships. Definately a cut above the average lunar lander!!

£5.50

GOLF (6K, F.P., BASIC)

An 18 hole, par 72 course, complete with fairways, rough, bunkers, trees, streams & greens. Skill and careful club selection are required to get round with a good score. To make things more difficult, you have to specify a fault in your game, which the program will reproduce, and your handicap. At the end of the round, the program produces your scorecard for the round.

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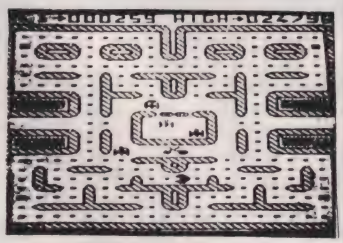
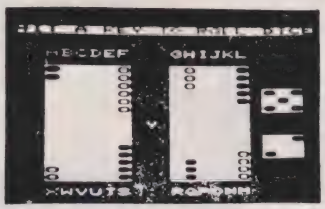


VICGAMMON

Standard Backgammon game for the VIC with 3K expansion. Rapid computer responses. Instructions on how to play are included.

SUPPLIED ON CASSETTE @ £7.00



More VIC software will be available by the time you read this. Phone 051 227 2642 for details. Generous DEALER DISCOUNTS available - phone Dave on 051 227 2299 for details.

Sinclair ZX81 * NEW RELEASES *

DICTATOR

Another great adventure game from Bug-byte for the 16K ZX81. This time, you are the president of a small state. The object of the game is to avoid revolution, escape assassination attempts, and maintain your popularity, while managing the secret police and army, and maintaining a secure economy. This is a very complex simulation, utilising the whole 16K, and the cassette comes with an 8-page booklet giving full instructions and hints on how to survive.

Can you stand stand up to the pressures of life as a dictator, and prevent unrest from spreading before it's too late?

PRICE £9.00

CONSTELLATION

Turn your ZX81 into a telescope! This program will produce a simulation of the night sky as seen from any chosen point on earth at any time this century. You can point your "telescope" in any direction, move it up, down, left and right, zoom in or pull out, and display the stars by magnitude or constellation. PRICE £8.00

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THE DAMSEL & THE BEAST	£6.50	VIEWTEXT	£7.00
STARTREK	£5.00	NOTE: all require RAM pack	

ACCESS/BARCLAYCARD orders accepted on 051 227 2642 (24 hrs)

BUG-BYTE SOFTWARE

98-100 THE ALBANY, OLD HALL STREET,

Dear Sir,
Might I make a couple of suggestions which would help me in using your published listings.

You sometimes print zero and the letter O such that they appear the same. When you are using the zero would it not be possible to use the slashed form, Ø?

The second suggestion concerns the use of a leading zero in decimal numbers such as .325, in poor print it is easy to miss the and 0.325 would be more easily recognised.

Yours faithfully
A Robinson
BFP0 40

(* We are now using the slashed zero exclusively in our printed listings and avoiding the use of 0 as a variable wherever possible. Your comment on leading zeros is quite valid and we'll see what we can do about that, we had hoped that the print quality was good enough! Ed. *)

Dear Sir,
If any of your readers with Acorn ATOMs live in the Manchester area they may be interested to hear of the formation of the Acorn ATOM Users Group (North) which meets fornightly at the Abraham Moss Centre, Crescent Road, Salford on Tuesdays between 7.00 and 9.00 pm.

Yours faithfully
John Ashurst
20 Verdure Close
Failsworth
Manchester.

Dear Sir,
I would be grateful if you could mention that the Mid Kent TRS-80 Users Club has been formed at the address given below.

Meetings will be held fortnightly and owners or potential owners of TRS/Video Genie systems are welcome. Further details can be obtained from either Tim Shepherd or myself at Kent Micro Services, 53 High Street, Maidstone, Kent.

Yours faithfully
Mike Marriott

Dear Sir,
I read with interest your survey of school computer usage and noted the omission of a mention for the Devon schools using the Apple. While not being a complete convert to the Apple or for that matter to any other particular machine as far as education is concerned, I feel that the Apple was played down slightly. Scotland as a whole is attempting to standardise on Apple and some good software is being produced for school's use.

Yours sincerely,
Mike Boston
Priory High School
Exeter

(* While being grateful for your observations, I must point out that this survey was done independently through the various education authorities. Several teachers have commented that the machine they use is not noted in the tables — this is because the relevant authority either didn't bother to include it in their reply or because the system has been purchased with private funds and is thus outside their knowledge. We have certainly not played down any particular system; to have done so would have destroyed any point to the article! If any of the authorities who failed to notify us of their choice of computer wish to update this, then we'll be only too pleased to extend our coverage. Ed. *)

Dear Sir,
Your readers may be interested to note the formation of the Furness Computer Club. We have a meeting place in Dalton-in-Furness and would welcome anyone of any age interested in the computing world as a hobby.

Details of venue and times can be obtained by contacting the below by letter or telephone between the hours of 6pm — 7pm weekday evenings.

Yours faithfully
A H Gay
24 Rusland Crescent
Ulverston
Cumbria
LA12 9LX
0229-52854

Dear Sir,
D S Peckett's article in the December 1981 issue of Computing Today about making music with a TRS-80 or Video Genie is very interesting, but he overlooks an important point. If you have a cassette recorder, as all TRS-80 owners certainly have, it is not necessary to modify your television or to buy an external amplifier.

A reasonable sound output can be obtained from the loudspeaker of the cassette recorder by removing the cassette and the EAR jackplug, plugging the AUX jack plug into the larger MIC jacksocket, turning up the volume setting and pressing the PLAY key.

By the way, if there are any other TRS-80 users in the Gutersloh area of West Germany, I would be interested to hear from them.

Yours sincerely,
Jim Bartholomew
Officers' Mess
RAF Gutersloh
BAFPO 47

(* Your comment brought a frown of worry to several brows, we were under the impression that we **had** made this point clear in the second paragraph but a quick re-read of the article reveals that it is not as clear as it should be. Apologies to anyone who's been confused and thank you Mr Bartholomew for pointing this out. Ed. *)

Dear Sir,
I should be grateful if you would publish details of the Scottish Amateur Computer Society (SACS) meetings in your PRINTOUT section

SACS meets at 7.30 pm on the first Wenesday of every month at the Claremount Hotel, Claremount Crescent, Edinburgh. Each meeting includes a talk on some aspect of hardware or software, or equipment demonstrations provided by local dealers. Education sessions are provided, covering introductions to computing, BASIC and Assembler programming, hardware and software design techniques, etc.

Members are encouraged to bring their systems to meetings. Machines regularly on show include NASCOM, Apple, PET,

Tangerine and SuperBrain.

Visitors are always welcome at these meetings. For further details, contact the secretary·—

Pete Lindsay
(Top right Flat)
1 Lower Gilmore Place
Edinburgh

In addition to regular SACS activities, we are participating in the BBC Computer Literacy Project Referral Service.

Yours sincerely
W Davidson
(Publicity Secretary)

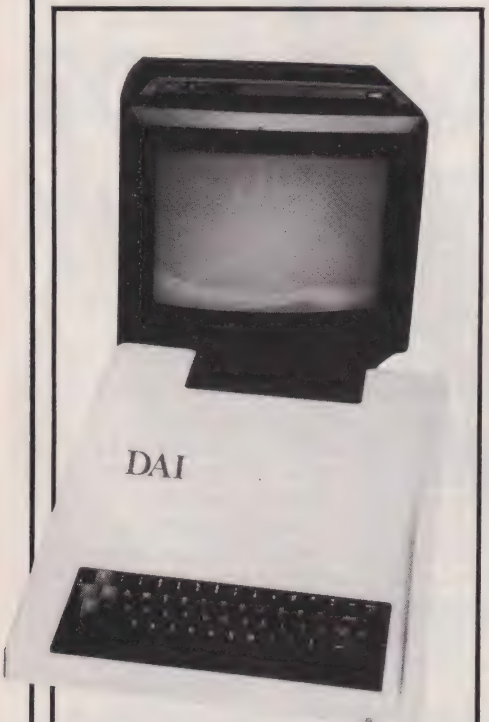
Dear Sir,
In K Davies' 'Cross Hatcher' program in your December issue there is a misprint in Line 230. It should be:

230 DRAW XMAX/2,0 XMAX/2, YMAX 15

OK it's only a comma instead of a full stop, but as the DAI gives one trailing zero in floating point mode, it is relevant.

Despite this, I am very pleased to see another DAI program and wish we could see a few more for this somewhat neglected machine.

Yours sincerely
Dave Atherton
Manchester



More software for this colourful system please

Dear Sir,
I recently read the very good review of the new Tandy Line Printer VII in your January '82 issue. I would, however, like to correct the author on a couple of points which could otherwise be misleading. Contrary to the author's belief that the printer does not accept a form feed command, when hooked to a TRS-80 the statement 'LPRINT CHR$(11)' will cause the printer to advance the paper to the top of the next form. As this is not mentioned in the literature accompanying the printer this slight error can be forgiven. Not so for the next point though. The author states that on the printer he tested, the printout was blurred slightly. However, my printer does not suffer from such afflictions and produces what I can only call very acceptable characters. To prove this I have used the printer to produce this letter and can only presume the author had a bad specimen. Also, having used the printer for some time now I can affirm that the marks left on the paper due to the proximity of the ribbon do in fact cease after a short 'running in' period and are nothing to worry about.

I hope that this letter will correct any prospective purchasers of a Line Printer VII and that should they buy one of these excellent machines and enjoy many trouble-free years of printing with it. Thank you.

Yours faithfully
S Rainey
Lancashire

(* Thank you for your comments, Mr Rainey. A couple of other points have come to light since our review was published; the price is now £239 including VAT and apparently the printer can be used in connection with the High-Res graphics add-on that Tandy are now offering for the Model 1 at £169. This modification is essentially a ROM upgrade and takes no user memory, it also includes the lower case mod that was previously available separately. Ed. *)

Dear Sir,
The 6th Form 'A' Level Group of our school is currently working on a network system for CBM 4032 micros. At present, we have successfully programmed (in BASIC) and implemented a system to allow keyboard conversation between two CBM's using a connector (constructed by ourselves) for use with the Parallel User Port.

Anyone wanting further information (ie how to construct the connector and documentation of our two-way PET-Talker) should write to the address given below.

Also, it would be appreciated if anyone who has done, or attempted to do, a similar system would write to use with their ideas.

Yours faithfully
Upper 6th Form 'A' Level Group.
J Cantrill
N Dutton
S Hancock
N Hudson
A Lakin
N West
Computer Studies Dept.
The Pingle School
Swadlincote
Burton-on-Trent
Staffs
DE11 0QA.

Dear Sir,
The Manpower Society is intending, next September, to organise a conference on Computing Personnel Records, especially Microcomputerisation. As part of that process, they have asked me to survey the packages available on the market. Could I enlist your support in any of the following:-

a) finding any exisiting reviews of this area;
b) obtaining a list of software companies who manufacture such software;
c) obtaining any evaluation data available on these packages.

I would be grateful for any help you or any of your readers could offer.

Yours faithfully
P W Hare
10 Grasmere Gardens
Redbridge
Essex
1G4 5LF

(* If any readers have experience with any of the systems mentioned then I'm sure Mr Hare would be grateful for your comments. Ed *)

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You'll find all the help and advice you need about the MZ-80K at your Specialist Sharp Dealer in the list below.

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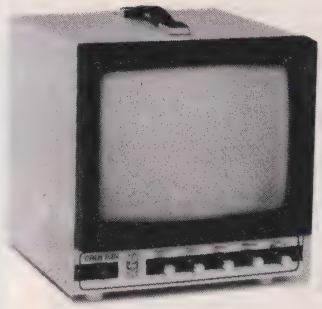

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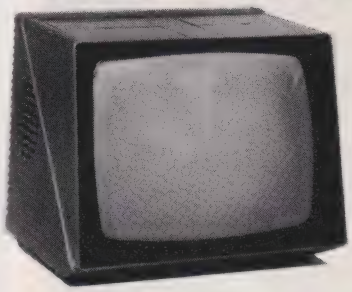

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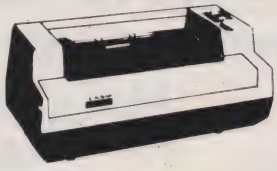

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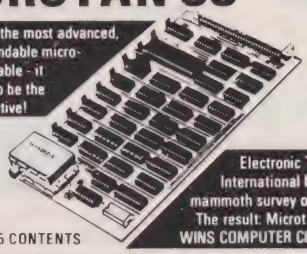

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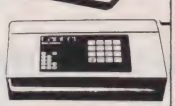

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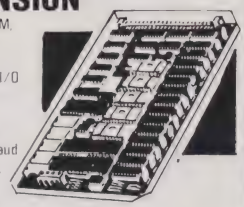

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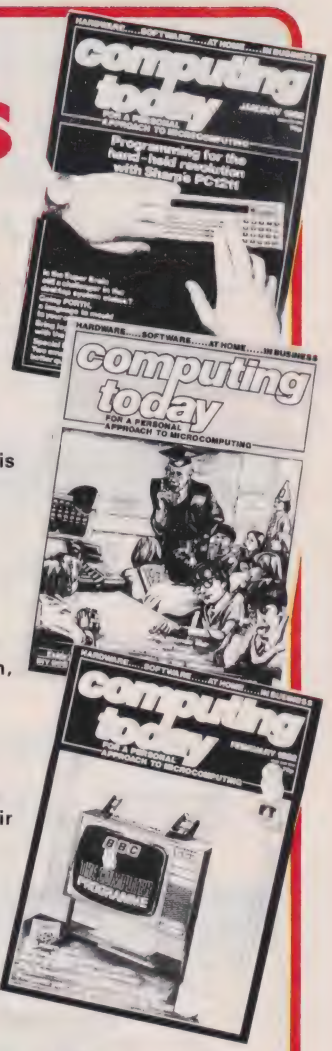

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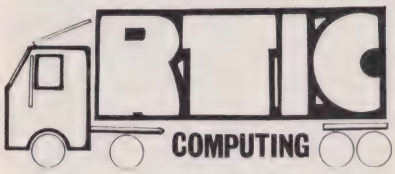

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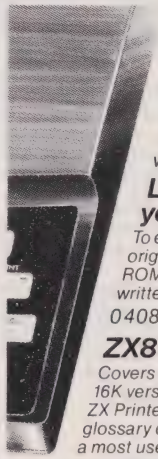

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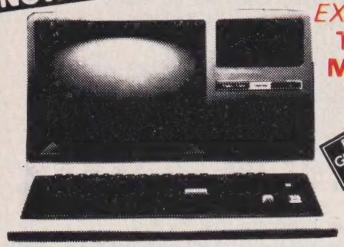

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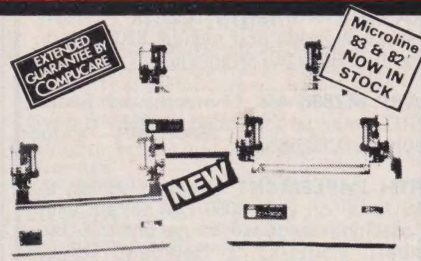

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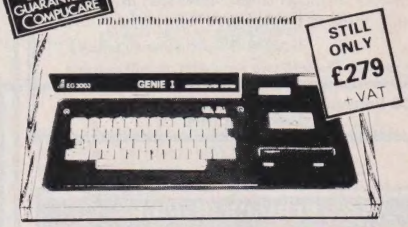

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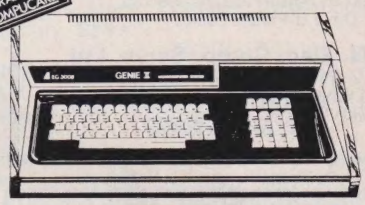

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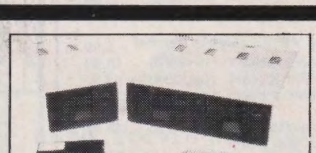

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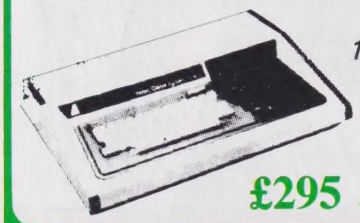

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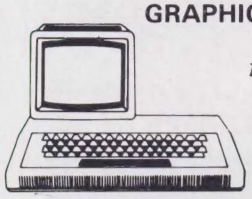

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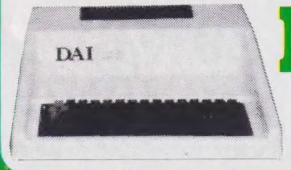

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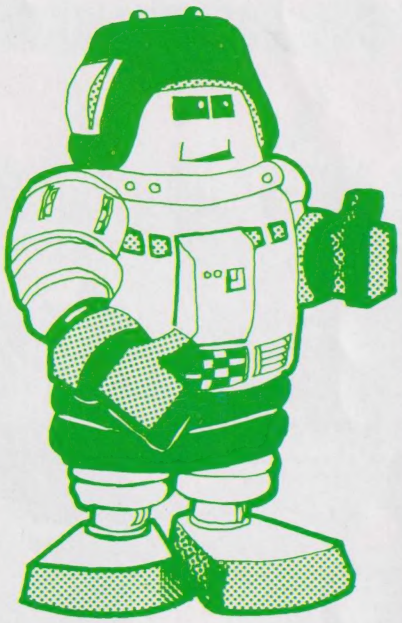

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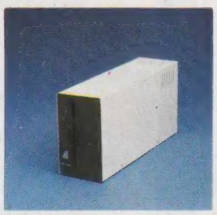

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